An Analysis of Crude Oil Market's Shocks on Pakistan Economy

By

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SCHOOL OF ECONOMICS,

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بسم الله الرحمن الرحيم

Declaration

I **Mansoor Ur Rehman**, son of **Muhammad Suleman Khan**, Registration No: 02091911018, Candidate of MPhil Economics at School of Economics, Quaid-i-Azam University, Islamabad, do hereby declare that the thesis entitled "**An Analysis of Crude Oil Market's Shocks on Pakistan Economy**" submitted for the fulfillment of Master of Philosophy (MPhil) degree in Economics, is my own work. I have not previously presented any part of this work for any other degree.

Mansoor Ur Rehman

Certificate

This is to certify that the thesis titled **"An Analysis of Crude Oil Markets Shocks on Pakistan Economy"** submitted by **Mansoor Ur Rehman S/O Muhammad Suleman Khan**, Registration No: 02091911018 is accepted in its present form by the School of Economics, Quaid-i-Azam University, Islamabad, as satisfying all the requirements for the fulfillment of the degree of Master of Philosophy in Economics.

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TO

MY SONS

UZAIR, ABDULLAH AND ABDUR REHMAN

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Abbreviations

OP Shocks	Oil Price Shocks
NOPI	Net Oil Price Increase
OSS	Oil Supply Shocks
ODS	Oil Demand Shocks
ADS	Aggregate Demand Shocks
OMSDS	Oil Market Specific Demand Shocks
PDS	Precautionary Demand Shocks
COP	Crude oil Production
REA	Real Economic Activity
RPO	Real Price of Oil
REER	Real Effective Exchange Rate
SP	Stock Prices
CPI	Consumer Price Index
IP	Industrial Production
SVAR Model	Structural Vector Autoregressive Model
KSE	Karachi Stock Exchange
IRFs	Impulse Response Functions
VD	Variance Decomposition
FEVD	Forecast error variance decomposition

Abstract

The study objective is to decompose the real oil price dynamics or to identify the main sources of oil price (OP) shocks based on extended and updated data from Feb-1974 to Sep-2020 and then our second objective is to investigate the effect of each identified source of oil price shocks on output, inflation, stock prices and exchange rate of pakistan. To achieve this objective the study employs a Structural Vector Autoregressive (SVAR) Model of global oil market developed by Kilian, (2009). The results suggest that the magnitude of real oil price response differ greatly to the three sources of oil price shocks, namely oil supply shocks (OSS), oil demand shocks (ODS) or aggregate demand shocks (ADS) and oil-market specific demand shocks (OMSDS) or precautionary demand shocks (PDS). From the results of impulse response functions (IRFs), and variance decomposition (VD) we find that the oil demand shocks, and oil-market specific demand shocks are the major contributor by affecting the changes in real oil price. The negative oil supply shocks also affect the real oil price changes but relatively small. From the results of historical decomposition of real oil price shocks, we find that the recent sharp fall in oil prices was primarily due to a sharp decline in aggregate demand caused by slowdown in global economic activity due to COVID-19. And the second reason for this decline was due to sharp fall in precautionary demand for oil.

The results from second part of our analysis suggest that the oil price increases have a different effect on output, inflation, stock prices and real effective exchange rate of pakistan, depending on the underlying sources of oil price shocks. From these results we find that the oil price increases that result from negative oil supply shocks affect the pakistan economy interms of output loss and a depreciation of real exchange rate. While the oil price increases that result from higher oil demand caused by global growth in economic activity, affect the pakistan economy interms of

higher inflation, increasing stock prices and a short-term depreciation of real exchange rate. Finally, the oil price increases due to increases in precautionary demand for oil affect the pakistan economy interms of higher inflation, short-term increase in stock prices and a depreciation of real exchange rate.

Chapter: 1

Introduction

1.1. Background of the Study.

Oil is one of the important resources and play a significant role in the growth of an economy. The reliance on oil of developed and developing world like pakistan is increasing day by day due to industrialization, urbanization, transportation and increasing use of technologies. Oil can be considered as a major source of energy consumption, because pakistan mainly depends upon oil as well as natural gas to fulfill the energy requirements. The demand for energy of Pakistan has been increased with the passage of time. According to U.S Energy Information Administration (EIA) the total energy consumption of pakistan during the FY- 2018 was 92.60 million metric tons of oil equivalent (TOE) as compared to 86.30 million metrics (TOE) in FY-2017, which indicate increasing pattern of energy consumption in Pakistan, and this portion of energy consumption largely involved in support of oil and natural gas.

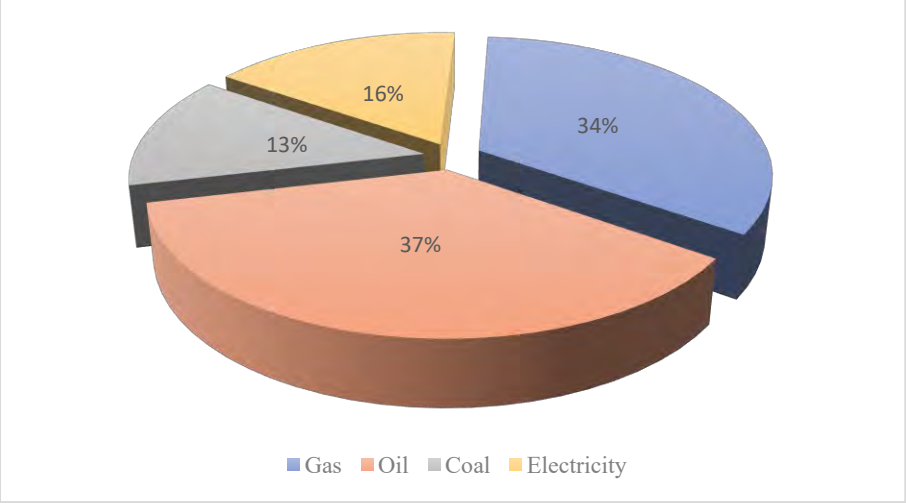


Figure 1.1: Energy Mix of Pakistan for 2017

Source; International Energy Agency (IEA)

Oil as a major source of energy consumption, pakistan consume 37% out of major energy consumption in 2017 and out of this consumption the country imports a large portion of oil from international market to fulfill the energy requirements. According to economic survey of pakistan 2019-20 the country consumed 19.68 million tons of crude oil in which 11.59 million tons produced by domestic supplier and the remaining 8.09 million tons is being imported. According to pakistan economic survey 2018-19 the quantity of oil imported was 6.6 million tones as compere to 7.8 million tones corresponding period last year. This declined in crude oil import associated mainly with the increase in international oil prices. The consumption of oil is transmitted as an input in industrial production, transportation, and for electricity generation that's why mostly oil price shocks cause the pakistan economy in term of production losses and inflation and their second round affect it can lead to rise in interest rate due central bank response toward controlling inflation and a depreciation of exchange rate due to higher imports bills which can reinforce the output loss and inflation (Zeshan *et al*., 2019). The pakistan spends almost 60 % of their foreign exchange reserves on the imports of fossil fuel from global market (Latief & Lefen, 2019). So being a net oil importer its necessary to better understand the effects of oil price (OP) shocks on pakistan economy.

OP shock is a surprising shift in oil prices, and some scholars such as Baumeister and Killian, (2016) have described the OP shock as the difference between realized and expected oil prices. Park and Ratti, (2008) is also defined as a percent change in oil prices. Energy (oil) price increase are fundamentally different from price rises for other commodities. This difference come up with a reason is that increase in energy prices matter more than other goods because of relatively inelastic energy demand (Kilian, 2008). As a result, variations in crude oil prices have been seen as a major source of disturbing the economic conditions.

1.2. An Overview of Developments in the Literature.

The oil crises of 1970 have been attracted the academics, policy makers and even general public interest to understand the underlying causes as well as consequences of oil price fluctuations. Following these crises, considerable empirical influential studies found significant relation among oil price increases and economic activity declines. Hamilton, (1983) was the first who tested this link by linear regression model and their major finding was that the oil prices affect the macroeconomy significantly and highlighted that, out of eight postwar recessions in the U.S in which seven recessions has been occurred due to oil price shocks. Later mostly literatures have fallowed and extending the Hamilton baseline work by using different data sets and estimation procedure. Burbidge and Harrison, (1984) indicated that, higher inflation in case of U.S and canada while lower in case of japan, Germany and U.K attributed to oil price shocks. Whereas U.S and U.K production declined largely due to shocks to oil price but in case of other countries their affect appears quite small.

Until the beginning of 2000s the growing concerned was, to investigate the impact of changes in oil prices on macroeconomic indicators without identifying the sources of the OP shocks. The common belief was that, historically large changes in crude oil price has been driven by supply disruptions caused by exogenous political or other events in the oil-exporting countries, that is why the changes in oil price caused by exogenous events was considered to be exogenous with respect to domestic as well as global macroeconomic aggregates, (Mork, 1989; Lee et al., 1995; Hamilton, 1996, 2003). A common feature of these studies was that the OP shocks negatively affect the output and increase prices. In addition, later research that relied on the vector autoregressions and their standard assumption was that the oil prices are predetermined with respect to domestic economic conditions which indicate that, there will be no contemporaneous feedback from

domestic economic conditions to the OP shocks. or more specifically the individual country has no influence in the international crude oil market, (Rotemberg & woodford, 1996; Davis & Haltiwanger, 2001; Lee & Ni, 2002).

Barsky and Kilian, (2002) Was the first and argue that exogeneity assumption can be problematic because oil prices can also response to changes in oil demand caused by fluctuations in worldwide real economic activity (REA) and thus these conditions violating the assumption of exogeneity. So, this means that the OP shocks are a result of both oil supply as well as demand forces, that is why the Litrature have aimed to classify the causes of shifts in oil prices as well as to estimate the effects of shocks driven by supply and demand.

Kilian, (2009) identified the sources of real oil prices dynamics by using the Structural VAR Model based on exclusion restrictions. These sources come up with oil supply, oil demand and oil specific demand shocks. Their result from this decomposition of real oil price dynamics revealed that historically, oil supply shocks contributed less to the fluctuations of oil prices whereas large part of oil price fluctuations has been driven due to both demand shocks. Furthermore Kilian, (2009), argued that, this decomposition of the oil price changes can have important macroeconomic implications such that, if the oil price increase driven due to aggregate demand shock then it will have different effects on macroeconomic indicators than if such increase driven due to supply or precautionary demand shock. Kilian provided an example that this decomposition analysis can help by explaining the puzzle that, the oil prices increase between 2003-08 period, which never cause the recessions in major industrialized countries because such increase was mainly resulted from higher crude oil demand caused by worldwide strong growth in economic activity rather than oil supply as well as precautionary demand shocks.

Kilian and Murphy, (2012) extended the framework established by Kilian, (2009) by using sign instead of exclusion restrictions to achieve identification and their results resembled to Kilian, (2009), that only a small fraction of OP shocks explained by supply disruptions. Later, Kilian and Murphy, (2014) They advanced their own methodology (i.e., Kilian and Murphy,2012) to account for speculation that driving fluctuations in oil prices by including global oil inventories in their analysis by using Structural VAR model also based on sign restrictions and modified the identification assumptions accordingly. Consistent with pervious findings they also revealed that, the supply disruptions clarify small share of variations in oil price relative to both oil demand and speculation demand shocks. Later mostly literatures have fallowed and extending the influential work of Kilian, (2009) and Kilian and Murphy, (2014).

Existing literatures in case of pakistan also produced the results on the macroeconomic effects of shocks to oil prices. Malik, (2008) found that, oil prices fluctuations have significant and asymmetric association with macroeconomic variables. Arshad and Ahmad, (2011) found that, the OP shocks affect the pakistan economy interms of short-term reduction in output and increasing the inflation. In addition, they find that the domestic currency depreciates initially and then it appreciates gradually over the 24-month horizon. The interest rate response positively because of oil price increases leads to high inflation can be through rise in price of imported commodities and petroleum products then central bank increase interest rate to cope with inflation. Ahmad et al. (2017) Their analysis revealed that, the industrial production response is negative to oil price shocks. Malik et al. (2017) finds that OP shocks effect the real GDP adversely and depreciate the exchange rate and have to rise the interest rate and inflation. Zeshan et al. (2019) found that, ensuring tight monetary policy to cope with inflation mainly increases by OP shocks will lessen output by around 42% in case of Pakistan after encountering the Lucas critique.

Mostly the literature on OP shocks and their macroeconomic effects in case of pakistan are based on by using average oil price series and net oil price increase (NOPI) as a measure of OP shocks but the decompose real oil price framework developed by Kilian, (2009) which we have discussed earlier has mainly addressed by developed world and has not been explored by existing research in case of pakistan. That is why we have still the gap to analyze the macroeconomic effects OP shocks by using decomposed oil price framework.

1.3. Gap Identification.

The present study fill the gap by the following ways in case of pakistan.

The literature on causes and consequences of OP shocks have been addressed by developed and developing countries like pakistan by using average oil prices and NOPI as a measure of OP shocks. The recent developments on this issue in the literature by Kilian, (2009) and Kilian and Murphy, (2014) whose decomposed real OP shocks. For example, Kilian, (2009) identified the key determinants of OP shocks namely oil supply shocks, oil demand or aggregate demand shocks, and oil market specific or precautionary demand shocks, and investigated their effects on U.S output and inflation. This development by Kilian, (2009) can have important implications for better understanding that how oil price fluctuations affect macroeconomy, but this decomposition framework has mainly addressed by developed world and has not been explored by existing research in case of pakistan except only for Khan et al.(2019), but their study contributed by investigating the effects of OP shocks on investment behavior and we have several contributions first, by including other macroeconomic variables, such as output, inflation, stock prices and real effective exchange rate. Second, extending the sample period to 2020 and third, using the updated and corrected version of monthly index of global REA. Thus, the case of pakistan is different from

other developed countries, the literatures available on this issue (decomposition framework) in developed world is inadequate for making appropriate and correct policy decisions.

1.4. Research Objectives.

For further better understanding the macroeconomic effects of OP shocks, the study attempts to achieve the following objectives.

1. To identify the three main sources of oil price shocks: Oil supply shocks, Oil demand shocks and Oil-Mark specific demand shocks.

2. To investigate the effect of each identified source of oil price shocks on output, inflation, stock prices and real effective exchange rate of pakistan.

1.5. Hypothesis of the Study.

$H_1$1: The effect of OP shocks driven by oil supply shocks and oil market specific demand shocks are negative while the effect of OP shocks driven by oil demand shocks is positive on the industrial production/ output of pakistan.

$H_1$2: The effect of OP shocks that resulted from oil supply shocks, oil demand shocks and oil market specific demand shocks are positive on the consumer price inflation of pakistan.

$H_1$3: The effect of OP shocks caused by oil supply shocks and oil demand shocks are negative whereas the effect of OP shocks caused by oil demand shocks is positive on the stock prices of pakistan.

$H_1$4: The effect of OP shocks determined by oil supply shocks and oil market specific demand shocks are negative while the effect of OP shocks determined by oil demand shocks is positive on the real exchange rate of pakistan.

1.5. Significance of the Study.

The significance of this study is to better understand the effects of sources of OP shocks on pakistan economy, for this purpose we implemented the Kilian, (2009) decomposition framework through SVAR model. The central massage from decomposition of OP shocks is that the underlying causes of OP shocks may have different effect on oil prices and on macroeconomic variables. For example, we find the oil production disruptions causes a small but almost smooth increase in real oil price over the impulse response horizon. The increases in oil precautionary demand causes immediate, persistent, and large increase in real oil price while increases in oil consumption demand caused by stronger growth in industrialized countries causes an immediate, but sustained increase in oil price. So different sources of OP shocks effect the oil price increase differently and their effect on macroeconomic variables are also different. e.g., We also find that the oil price increases caused by crude oil demand shocks have a different effect on macroeconomic variables than oil price increases caused by negative oil supply shocks and precautionary demand shocks. The increase in real oil price that result from negative supply shocks affect the pakistan economy interms of output loss and a depreciation of exchange rate. The decline in output may be due to higher cost of production because most industries use oil as primary input, so the higher oil prices raise the marginal cost of production which result reduction in growth of output. The depreciation of exchange rate may be due to higher import bills which can put pressure on the domestic currency to depreciates. While the increase of oil prices that result from oil demand shocks affect the pakistan economy interms of higher inflation, increasing stock prices and a short-term depreciation of exchange rate but not cause the output loss. The increase in oil prices as a result of increased in oil demand are mostly in case prosperous economic environment. The global economic boom and the effect of higher oil prices can work in same direction for some variables

such as inflation and can work in opposite direction for some variables for example, output, and stock prices. Finally, the oil price increases that result from oil precautionary demand shocks affect the pakistan economy interms of higher inflation because of higher production cost that can pass the producers through selling prices and a short-term increase in stock prices and a depreciation of exchange rate that may be due to higher import bills. Thus, these results from the decomposition framework suggest the importance of understanding the sources of OP shocks to better cope with their effects on pakistan economy.

1.6 Organization of the Study.

The remainder paper is divided into different sections with different aspects. Section 2 is consists of reviewing the relevant literature. Section 3 provides the theoretical framework. Section 4 is about the methodology of how to identify the main sources of OP shocks and how to investigate these identified sources of OP effects on output and inflation of Pakistan. Section 5 is consists of the discussion of the results. Finally, section 6 presents the study conclusion and provides policy recommendation.

Chapter: 2

Literature Review

2.1. Introduction.

The 1970 oil crises have been attracted the consideration of economists, policy makers, and even general public by investigating OP shocks and macroeconomy link. There are huge numbers of literature examined the economic effects of OP shocks in international setup where the studies argued that OP shocks have been affected the macroeconomy through increase in inflation, slow down in productivity, monetary policy changes, labor market adjustments, changes in energy technologies, and worsens terms of trade.

The literature on OP shocks can be divided into different groups with different aspects. In the next section 2.2 we will review the literatures based on predetermined oil price framework and the VAR models that relied on their standard assumption such as predetermined oil prices, which indicate that there will be no response from domestic economic conditions to oil prices. In addition, the section will also review the Litrature based on net oil price increase measure whose treated such measure is purely exogenous. In section 2.3 we will focus on the literatures that has been used structural vector autoregressions which jointly explain oil price determination and their macroeconomic outcomes. In section 2.4 we will focus to summarize the literature on the link between OP shocks and macroeconomic activities in pakistan context. Finally, in section 2.5 will provide the detail on what gap we have identified after reviewing the literatures and how to fill this gap.

2.2. The Literature that Treated Oil Price Shocks Predetermined and Exogenous.

There was a considerable interest of policy makers, economist, and even general public to highlight the reason behind the stagflation of 1970 and the subsequent periods. The common view attributed it to OP shocks and provided possible explanation that, low production and high level of inflation (adverse shift in aggregate supply curve) was mainly due to OP shocks. Following these crises, growing empirical work has been established and found significant association among higher oil price and contraction in economic growth.

Hamilton, (1983) was the first who tested this link by linear regression model and their major finding was that the oil prices affect the macroeconomy significantly and highlighted that, out of eight postwar recessions in the U.S in which seven recessions has been occurred due to OP shocks. Later mostly literature has fallowed and extending the Hamilton baseline work by using different estimation procedure as well as data sets.

Burbidge and Harrison, (1984) They investigated the effect of OP shocks for five OECD countries by estimating vector autoregressions (VARs) for each country and then convert it to their moving average representation and then they used innovation accounting techniques of sims(1980a) and their result from impulse responses specified that, higher inflation in case of U.S and canada while lower in case of japan, Germany and U.K attributed to OP shocks. Whereas U.S and U.K production declined largely due to shocks to oil price but in case of other countries their affect appears quite small. Finally, their result from historical decomposition put significant difference with respect to different shocks such as the oil price shock of 1973-74 has strong impact on output and inflation while the 1979-80 shock impact appear minimal on these variables.

Gisser and Goodwin, (1986) Found that, the OP shocks have both strong real and moderate inflationary effects for U.S economy, because They showed that the results have compatibility with macroeconomic models of inelastic aggregate supply and elastic demand such as the shocks of oil prices shift the economy output supply adversely which result the real output decline will be larger than price increases.

After 1986 oil price reduction, the researchers become interested to further explore that how OP shocks affect economic activity by adding more periods of OP shocks and modified their methodologies and demonstrated important argument that the oil price-macroeconomic relationship over the time is unstable, and further suggested that this instability attributed to asymmetric response from economic activities to oil price increase and decrease.

Mork, (1989) Provided an important argument that wither the Hamilton results remain persist if once extend the sample and to include the decline in oil prices such as 1986 collapse of oil prices and to incorporate the price control effect. He argued that Hamilton, (1983) established strong relationship that higher oil prices depress the U.S economic activities such as real GNP growth rate but he included the oil price variable in which approximately all oil price movements was upward that is why he may not be able to answer for instability in the relationship. and second the price variable he used was somewhat distorted by price control in the 1970. Thus, if once include the decline of oil price and then regress the U.S GNP on lags of rise (Falls) in oil price. Mork found that the GNP response to lags of oil price rise was jointly significant and negative while in case of decrease it seems to be insignificant. So Mork conclude that, the U.S real GNP and oil price increase (decrease) have asymmetric relationship.

Mork and Olsen, (1994) Once again verified the asymmetric relationship for most OECD countries. They found negative (significant) correlation among oil price increase and GDP except

only for Norway where it was positive because of large oil producing sector, while on the other hand they initiate that the decrease of oil price leads to expansion in national output of Seven OECD countries but its only significant for canada. Thus, they again point out that, the industrialized nations show asymmetric responses except only for canada. Lee and Ratti (1995), come with same conclusion and conclude that, positive OP shocks have significant impact on economic activities while negative does not.

Hooker, (1996) Further explored important debate by challenging the Hamilton, (1983) Burbidge and Harrison, (1984) and other findings. He revealed that, there is necessary to concentrate on the sample stability issues, because the oil price data can granger cause the U.S economic activities up to 1973 but after this period the oil price no longer granger cause the U.S economic activities. The oil price before 1973 can be treated as exogenous but after 1973 it seems to be endogenous. He further argued that the large oil price increase periods which associated to exogenous events has significant impact while the impact of the decline such as 1986 collapse of oil prices seems to be smaller that's why he provided the argument that the symmetric and linear specification do not incorporate properly the prices and macroeconomy relationship.

The common view reported that, oil price-national output or employment relationship are non-linear then the instability in the relationship can be found because of misspecification of the functional form. Motivated by these arguments Hamilton (1996 ,2003) purposed a methodology by answering the following two question.

1. if there is the issue of the non-linearity or functional form of the relationship then there are many alternative non-linear specifications which one should be use or appropriate for the analysis.

2. the correlation to be given causal interpretation he sperate the exogenous components behind the oil price shocks (such as exogenous political events e.g., military conflicts etc.) which in turn the oil price shocks can be treated as exogenous for macroeconomic outcomes.

To address these issues Hamilton introduced asymmetric functional form which was based on non-linear transformation of real oil price (i.e., Net Oil Price Increase), which can be treated as exogenous, and that corrects for instability in the relationship. The conclusion of their study was that the linear instrumental variable regression in which he used the five military conflicts as an instrument for shocks to oil price their predictions was very similar to the results obtained from non-linear specifications because of the non-linear transformation of real oil price filter out various endogenous factors which historically contributed to oil price changes. That is why he argued that the success of net oil price increase (NOPI) measure that can be treated as exogenous for macroeconomic activities. Thus, the non-linear models become the workhorse of empirical literatures for several years.

To explain large recession and asymmetric response of national output or economic activity to OP shocks, the empirical works further expands the economic impacts of OP shocks to aggregate as well as disaggregate level. the empirical studies also emphasized that, the uncertainty effect can play crucial role in the discussion of asymmetric responses.

Lee et al. (1995) was the first study by exploring the importance of oil price uncertainty for deriving force of economic activity. They highlighted that, the positive shocks to oil price has negative and significant affect while negative shocks predict insignificant result, and the nonlinear transformations of oil price series are more powerful to predict the recessions after 1986 oil price collapse.

Ferderer, (1996) Investigated oil price uncertainty role for variations in output in case of U.S to incorporate the importance of uncertainty about oil prices in asymmetric relationship of aggregate output to oil prices. He used the daily oil prices index to calculate monthly volatility measure of oil prices. He finds that the uncertainty about oil price affect output of U.S adversely and help to forecast fluctuations in aggregate output of U.S. he further found asymmetric reaction of economic activities to OP shocks. However, Lee et all. (1995) and Ferderer, (1996) their studies was about exogenous oil price increase and Elder and Serletis (2009 a, b) has relaxed this assumption and they allowed for the lagged feedback to oil prices from macroeconomic aggregates.

Elder and Serletis, (2009a) Estimated a SVAR with bivariate GARCH (in mean errors) in which the uncertainty about shocks to oil prices is the conditional standard deviation of one period ahead forecast error of oil price changes. Their main result was that the oil price uncertainty has negative (significant) effect on the output of U.S. They further noted that, if once account for uncertainty about oil prices the output decrease will be reinforced due to positive shocks of oil prices because of oil price uncertainty while it will have dampening effect on output boom in response to drop in the prices of oil. Further their result from disaggregates analysis of investment highlighted that, the domestic mining expenditures drop precipitously due to negative shocks of oil price whereas expenditures on mining have to increase much less dramatically in response to positive shocks in oil price. In addition, their result from descriptive analysis shows that, the oil price uncertainty was low between 2002-08 period despite the oil price increase. Finally, they derived conclusion from his results that the oil price uncertainty can help to explain the failure of sharp drop of oil prices in mid 1980s where there is necessary that this decline should encourage output growth, but this oil price decline not encouraged the output growth in many industrialized countries. And the second

failure, oil price increase historically has been caused major recessions but the steady increase in price of oil from 2002 through 2008 was failed to cause the recession in U.S and elsewhere.

Elder and Serletis, (2009b) They analyzed the same relationship in case of canada and highlighted that high level of uncertainty about future oil price fluctuations tends to reduce the industrial production in goods, mining and oil and gas extraction in canada. In addition, they also confirmed from his result that the lower price of oil will not bring the boom in output if it's accompanied by high uncertainty about the future prices of oil while the negative output response associated with higher oil prices will be reinforced due to uncertainty. They provided additional evidence of asymmetries in the relationship of oil prices and output and demonstrated main reason for this asymmetric relationship by indicating that, Canada output has been declined in mid-1980s despite collapse in oil prices because of in this period the uncertainty was soared.

Monetary policy response to OP shocks can be an additional reason for asymmetric relationship because the monetary authority behaves asymmetrically to OP Shocks. E.g., in case of increase in oil prices the central or federal reserve banks reacting by increasing the interest rates while in case of drop in oil prices its does not. So, the interest rate increase will reinforce the output decline which can produce asymmetric relationship.

Bernanke et al. (1997) Employed Monthly Structural VAR to analyze the systematic monetary policy effect on economic activity in face of shocks to oil price. They noted that the alternate oil price measure such as NOPI purposed by Hamilton (1996, 2003) is one of the best among alternative indicators for investigating such analysis. They found that the positive oil shocks by itself contributed less to output drop while the tight monetary policy in response to these shocks was reinforcing about almost 25% of output loss.

Lee et al. (2001) Also noted that, the NOPI as a measure of OP shocks is more appropriate for explaining the japan real economic activity and for predicting the monetary policy reaction to OP shocks. They highlighted that the positive OP shocks induce the call money rate to increase, and such increase further strengthen the output declined. They further identified that the positive OP shocks can predict the policy reaction such that the first OP shocks in mid 1970s shows 2% of increase in call money rate and the second shock of 1979-80 indicate 2.5% increase in call money rate. Finally, they conclude that almost 30 to 50% of real activity loss in japan associated with monetary tightening following positive OP shocks.

To better understand, the transmission mechanism of OP shocks the empirical studies further attempted by focusing on demand side of economy. consumption being the large component of real GDP the researchers have attempted to focus that how OP shocks affect consumer expenditures. The attempted made by these studies provided important implication for answering the theoretical view whose argue that energy have small share in Real GDP (households and industrial energy expenditures) how can we explain large recession by energy shocks. while the empirical evidence was against and purposed major recessions associated with shocks to oil price. And second the allocative disturbances can explain the asymmetries in the oil price-output relationship. Some study finds there is no support for linear relation between oil prices and production/output if the allocative disturbance is indeed the mechanism by which OP shocks affect the economy. E.g., the run up of oil prices will decrease the demand for some commodities but at the same time it can possibly increase other goods demand. so large share of consumption in real GDP, to better understand this channel can explain large recession. Some evidence highlighted that, the OP shocks can have less significant/miner effects on the economy without incorporating the disruptions in consumers and firm's spending's caused by OP shocks.

Lee and Ni, (2002) They analyzed OP shocks impacts on demand as well as supply of different industries by employing identified VAR model. Their result from impulse responses indicates that, the industries based on oil intensive such as industrial chemicals and petroleum refinery associated with reduction in supply to OP shocks. While the other industries such as automobile the OP shocks have to reduce their demand predominantly.

Hamilton, (2009) Revealed that the key mechanism through which the shocks to energy prices leads to influence the economy can be considered as the disruptions in consumers as well as firms' spending's on the goods and services, other than energy.

The common view was that, shocks in energy prices affect the consumption through four complementary channels. Edelstein and kilian, (2009) Attempted to answer the question that through which channel the energy price shocks affect the consumption. They showed that, the elasticities for aggregate consumption and for each disaggregate consumption components all are negative, such as for aggregate consumption if 1% increase in energy price then the total consumption will fall by -0.15%, and for disaggregate consumption level, they found the largest elasticity for durable goods consumption in which the decline in spending on motor vehicles contribute large share than other durables due to loss of purchasing power following higher energy prices and this view is consistent with existing evidence whose argued that, automobile sector suffered more in periods of higher oil prices. They further posit that, the total consumption has been decreased four times large as compare to reduction in discretionary income due to higher energy prices, this shows that the energy price shocks effect the consumption not only through lower discretionary income but other channels can operate such as the operating cost channel can be relevant because of large decline in motor vehicles spending in response to higher energy prices.

Finally, they concluded that, shocks in energy prices can be considered as important factor for reduction in real consumption of U.S economy.

While Kilian and Vigfusson, (2011) Criticized the earlier studies based on NOPI as a measure of OP shocks in their VAR analysis and noted that their results from impulse response estimate seems to be inconsistent and exaggerate the negative impact of oil price shocks. Instead, they purposed unrestricted Structural VAR model which was nonlinear but can incorporate symmetric as well asymmetric response of economic conditions to OP shocks. Their result from impulse response estimate highlighted that, the oil price increase have to contribute 0.47 percent decline in U.S real GDP while decrease contribute to real GDP increase by 0.39 percent, and this result is consistent with linear symmetric VAR model because the output almost symmetrically response to OP shocks. In addition, they argue that this result can improve the credibility of linear SVAR oil market model used by Kilian, (2009). Finally, they further criticized and indicate that the result can be inconsistent of the studies related to responses of monetary policy to OP shocks which has been used and argue that the NOPI measure has more predictive power to forecast the reaction of interest rate to OP shocks and further decline in output.

Kilian and vigfusson, (2017), Further investigated that, the model based on NOPI interpreted the U.S recessions differently than the linear models, because such models explain some part of the recession caused by other determinants as compare to OP shocks that's why such models shows time variations in the consequences of OP shocks while the linear model does not , so their statistical test reported that, linear model is best fit for the data than nonlinear model. Finally, they conclude that, the positive OP shocks have modest recessionary effect while negative have at least stimulating effect on economic growth which can improve the confidence on being to be except almost symmetric relationship.

However some evidence further identified that the asymmetric relationship can appears when large two standard deviation shocks has been taken into account and in some disaggregate data.

Edelstein and Kilian, (2007) Used multivariate recursively identified VAR model to investigate investment response to OP shocks and they found evidence of asymmetry in case of investment response to oil price increase and decrease.

Herrera et al. (2015), attempted to further explore the question about asymmetric relationship, they used industrial production data of 18 OECD countries of oil importer and exporter by employing simultaneous equations model which capture both symmetric as well as asymmetric effects. They found that, there is little evidence about asymmetric relationship but however in case of few countries (either oil importer or exporter) the asymmetric relationship can be found but not surprisingly because of the magnitude of asymmetries appears greater when two standard deviation shocks taken into account as compare to one standard deviation shocks. Finally they suggested that, linear model appears best to be fit for data about industrial production response to oil price shocks.

Herrera and Karaki, (2015) They used the simultaneous equations model to examine the U.S manufacturing job flows response to OP shocks. They found some evidence about asymmetric relationship in case of total manufacturing only along with two standard deviation shocks and the sectors which is oil intensive in energy consumption. But in aggregate they found no evidence of asymmetric and especially when once control for data mining.

2.3. The Literature Based on Decomposed Oil Price Framework.

Another alternative explanation provided by Kilian, (2009, b) for the instability of the relationship between OP shocks and macroeconomic outcomes. He argued that, the traditional VAR models

that relied on their standard assumption such as predetermined oil prices, which means there will be no feedback from domestic economic conditions to oil prices, and the models based on NOPI whose treated such measure is purely exogenous. The common perception of These models was that, the oil prices are exogenous and the higher oil prices leads to declines in output, and causes higher inflation. this result will be correct only whereas oil price increase caused by other than demand shocks. Kilian, (2009, b) provided an important argument that the oil prices are actually endogenous with global macroeconomic aggregates, and these prices can be driven by different sources such as supply as well as demand, and the oil prices determined by these sources can come up with different conclusion. He provided the example of the oil prices increase between 2003-08 period, which never cause the recessions in major industrialized countries because such increase was due to oil demand shocks caused by strong universal growth of economic activity, so the strong demand effect offset the negative effect of shocks to oil price. He provided another example such as the oil price increase during 1990 associated with causing recession because such increase driven by supply shocks.

Kilian, (2009) identified the sources of real oil prices dynamics by using the Structural VAR Model based on exclusion restrictions. These sources come up with oil supply and both oil demand shocks. Their result from this decomposition of real oil price dynamics revealed that historically, shocks in oil supply contribute less to the fluctuations in oil prices whereas large part of OP shocks has been driven due to both demand shocks. Furthermore Kilian, (2009), argued that, this decomposition of the oil price changes can have important macroeconomic implications such that, if the oil price goes up driven due to shock in oil demand, then it will have different effects on macroeconomic indicators than if such increase driven due to supply or precautionary demand shock. Kilian provided an example that this decomposition analysis can help by explaining the

puzzle that, the oil prices increase between 2003-08 period, which never cause the recessions in major industrialized countries because such increase was mainly resulted from higher crude oil demand caused by worldwide strong growth in economic activity rather than oil supply as well as precautionary demand shocks.

Kilian and Murphy, (2012) extended the framework established by Kilian, (2009) by using sign instead of exclusion restrictions and their results resembled to Kilian, (2009), that only a small fraction of OP shocks explained by supply disruptions. Later, further extension made by Kilian and Murphy, (2014) by incorporating the importance of oil speculative demand in OP shocks based on global oil inventories data. Consistent with pervious findings they also revealed that, the supply disruptions clarify small share of variations in oil price relative to both oil demand and speculation demand shocks.

Later mostly literatures has fallowed and extending the influential work of Kilian, (2009) and Kilian and Murphy, (2014).

Kilian and Park, (2009) used the same model developed by Kilian, (2009) for to analyze the three structural shocks impact on Stock prices. Their major findings were that the oil price rises in response to supply shocks have insignificant impact on stock prices of U.S. The shocks to oil demand have positive affect on stock prices for the first 11-months but its partially significant only for the first 7-months. while the precautionary demand shocks lower the stock prices of U.S significantly over the impulse response horizon.

Peersman and Robays, (2009) find that oil production disturbances which raise the oil prices lead to economic activity declines, permanent rise in inflation and have no effect on interest rate. The oil price goes up that resulted from shocks to oil specific demand associated with temporally

reduction in output and have negligible impact on inflation due to additional appreciation of euro exchange rate against U.S dollar. Finally, oil prices goes up driven by worldwide growth in aggregate demand have very strong positive effect on the euro area inflation and a temporary rise in economic growth and also a rise in interest rate.

Peersman and Robays, (2012) Examined the consequences of OP shocks driven by several types of sources across industrialized countries by using SVAR model. They find that, the oil prices increase due to both demand shocks explain similar effect across countries, such as shocks to oil demand driven by global economic activities leads to temporary rise in output, and have positive (significant) impact on inflation across countries, and the shocks to oil specific demand reduce the output temporarily and have a negligible impact on inflation across countries. While in case of the oil prices increase by exogenous supply disruptions share different results across net oil exporting and importing countries, such as supply shocks negatively affect the output and increase the inflation in oil importing countries while it's have insignificant effect on GDP or even positive in case of exporting countries of oil.

Cashin et al., (2014) They used the global VAR model based on sign restrictions estimated for 38-countries. They analyzed the influence of oil shocks on two group of countries, oil exporting and importing countries. Their results indicate that the oil importing countries affected from supply driven rise of oil prices with a long-lived drop in economic activities while the effect is positive for oil exporting countries. In addition, they also find that demand driven increase of oil prices have positive effect on oil exporting as well as importing countries on their real output, inflation and interest rate while the equity prices fall in response to demand driven rise in oil prices.

Gupta and Modise, (2013) Examined sources of OP shocks impacts on South Africa stock prices. They used sign restricted SVAR model based on sample period from Jan-1973 to July-2011. They

find that shocks to aggregate demand driven oil prices lead to increase the stock returns while oil price rises that resulted from shocks to oil supply as well as precautionary demand leads to reduce the stock prices. Degiannakis et al., (2014) They analyzed the OP shocks effect on Europe stock market volatility. Their findings emphasized that the supply as well as shocks to precautionary demand have no impact on stock prices while positive demand for oil lead to reduce the stock returns.

Basher et al., (2015) Used the Markov Switching Models by analyzing relation among oil shocks and exchange rate for importing and exporting nations of oil. They detect that shocks in oil demand lead to appreciation of oil exporting countries exchange rate, while in case of net importing countries of oil the impact is complex. On the other hand, they find limited effect of the supply shock on exchange rate of both group of countries.

Cunado et al. (2015) Extended the influential work of Kilian, (2009) to four asian countries by employing Structural VAR model and using sign instead of exclusion restrictions to identify the three different oil shocks effects and analyze their effects on four macroeconomic variables. They reported that, output and prices response differently, to oil prices depending on their types, such as oil supply shocks have negligible impacts in all four countries, while shocks in oil demand have a significant and positive effects especially on output and prices in these four countries. They also find that the policy responses help to stabilize their effect such as monetary as well as policies of exchange rate are more effective by stabilizing the effect of oil supply shocks on GDP and CPI of japan and Korea's. however, in case of india and Indonesia the exchange rates and interest rates do not play effective role to stabilize the inflation caused by oil price increase.

Chisadza et al., (2016) They investigated the macroeconomic consequences of shocks to oil supply and demand in case of south Africa by using SVAR model. They reported that, both demand

shocks, effect the real GDP positively while in case of supply shocks their effects seem to be insignificant. Supply and aggregate demand shocks has immediate but transient increase in inflation, while the shocks to oil specific demand have a negligible effect. The exchange rats react significantly to both demand shocks. Finally, their result seems to be insignificant throughout the impulse response horizons for all three shocks.

Guntner and Linsbauer, (2018) They investigated how the Michigan's University Consumer Sentiment Index (CSI) response to respective types of oil shocks by using recursively identified Structural VAR Model. They showed that, components of OP shocks have distinct impacts on the CSI because these shocks transmitted through different aspects of consumers expectations and perceptions, such that physical supply disruptions which increase the oil prices have negligible impact on CSI. They provided the reason for this limited effect that the United States consumers except that this increase of oil prices will be temporary because of if oil production decrease in one country can be quickly offset by another country. Shocks to oil precautionary demand have persistently negative impact on CSI. When prices increase caused by shocks aggregate demand significantly reduce the CSI throughout the impulse response horizons. They provided argument for the reduction that higher global industrial commodities demand which may cause higher oil demand and higher energy prices and this rise in industrial commodities demand globally further contribute to rise the household's income and employment, and this expected rise in nominal income can be offset by higher expected future energy and consumer prices, which they showed the later effect will be dominant for medium term.

2.4. The Literature on Oil Price Shocks in Case of Pakistan.

There are huge numbers of literature examined the macroeconomic effects of OP shocks in international setup and also macroeconomic variables response to OP shocks has been studied in

the context of pakistan. In this section we will focus to review the literatures on the link between OP shocks and macroeconomic activities in the context of pakistan.

Malik, (2008) Attempted to find out the impact of OP shocks along with others macroeconomic variable on output. Their results suggested that, oil prices and real output both strongly related, and this relationship seems to be Nonlinear. Arshad and Ahmad, (2011) Used monthly data from Jan-1990 to July-2011 and employed Structural VAR model to investigate macroeconomic variables response to OP shocks. They found that the OP shocks affect the pakistan economy interms of short-term reduction in output and increasing the inflation. In addition, they find that the domestic currency depreciates initially and then it appreciates gradually over horizon of 24-months. The interest rate response positively because of oil price increases leads to high inflation can be through rise in price of imported commodities and petroleum products then central bank increase interest rate to cope with inflation.

Ahmad et al., (2017) They examined the industrial production response to volatility in the prices of oil by estimating monthly Vector Autoregression's (VAR) model and their sample period was from July 2000 to June 2015. Their analysis revealed that, the industrial production response are negative for OP shocks.

Malik et al., (2017), They examined OP shocks effect on Pakistan's macroeconomic variables by Using SVAR Model on yearly data from period 1960 to 2014. Their results from IRFs revealed that, positive OP shocks effect the real GDP adversely and depreciate the exchange rate and have to rise the interest rate and inflation.

Zeshan et al. (2019) They used the Structural VAR framework to investigate the output response to exogenous increase of prices along with subsequent monetary policy reactions. They found that,

ensuring tight monetary policy to cope with inflation mainly increases by OP shocks will lessen output by around 42% in case of Pakistan after encountering Luca's critique. So, they argued that monetary policy reaction to control for inflation caused by oil prices increase, further leads to output loss.

Khan et al. (2019), They used the decomposed oil price framework purposed by Kilian, (2009) by identifying sources of OP shocks and analyzing the impact of these components of OP shocks on the stock market performance of pakistan. They invention that the causes of OP shocks effect on stock prices are not the same. The shocks in oil supply and demand have significant impacts on stock returns while shocks to oil precautionary demand does not play significant role.

2.5. Gap in the Literature

Pakistan being a net oil importer from international oil market, its necessary to better understand the transmission mechanism of OP shocks, in this context a lot of studies has been better investigated the relationship of oil price-pakistan economy. However, these studies have some limitations, such as mostly studies have used the average oil price and NOPI as a measure of OP shocks but not the decomposed oil price framework purposed by Kilian, (2009) which mainly addressed by the developed world but not serious attempted has been made in case of pakistan to use the decomposed oil price framework except only for Khan et al., (2019), but their study limited to the effect OP shocks on investment behavior. After reviewing the Litrature according to the best of our knowledge, there is no empirical work by analyzing the effects of sources of OP shocks on output, inflation, Stock prices and exchange rate in the context of pakistan. That is why we have still the gap to identify the sources of OP shocks and then to investigate these sources effects on output, inflation, stock prices and exchange rate by employing SVAR model of global oil markets developed by Kilian, (2009).

Chapter: 3

Theoretical Framework

In this chapter we will discuss the theoretical link that how the effect of OP shocks determined by the three main sources transmitted into the economy or to provide a theoretical links that how or through which channel the sources of OP shocks can affect the output, inflation, stock prices and exchange rate.

3.1. Sources of Oil Price Shocks and Output.

How the effect of increase in oil price will be transmitted into the economy by affecting the output if such increase caused by negative shock to oil supply, positive shocks to oil demand and precautionary demand. Mostly decomposed oil price models argued that the increase of oil price that result from negative supply shocks and higher precautionary demand for oil lead to reduction in output of those countries which is net oil importer (Kilian, 2009; Peersman and Robays, 2009, 2012; Cashin et al., 2014; Baumeister and Hamilton, 2019). The negative shocks to oil production and higher precautionary demand for oil their effect on output is almost similar because oil precautionary demand arises mostly in case of uncertainty about future oil supply shortfall relative to demand. Mostly theoretical Litrature about the transmission channels of OP shocks have explained the reason for this decline through supply and demand side effects of increasing oil prices on the economy. According to supply side effect, raising oil prices increase the marginal cost of production, which result reduction in growth of output and productivity because capacity utilization become lower than before (Brown & Yucel, 2002). Higher oil prices lead to adverse supply shocks, because of oil price increase leads to higher production cost and the economy aggregate supply will be decreases (Rotemberg & woodford, 1996).

Another branch of literatures whose introduced an alternative view where their primary focus was that the OP shocks can also affect the economic activities through demand side channels. Bernanke, (2006) stressed that rising energy prices are mainly hampering economic growth by having an impact on consumer spending. Hamilton, (2008) highlighted that shocks to energy prices transmitted within economy through disturbing the spending's of consumers and firms other than energy. Although the central massage from these literatures is that, higher prices of energy can reduce the discretionary income of households because consumers purchasing power decreases due to more expensive energy and the consumers have to spend more on transportations, electricity and gas bills and thus the households have less money after paying the bills of energy. In addition, the magnitude of higher energy prices will be larger to reduce discretionary income if the demand for energy is inelastic and in case of perfectly inelastic then it will be depend on share of energy in total consumption. So, the lower discretionary income can lead the consumers to spend less on other durables goods.

The rise of oil prices moves the purchasing power from oil importing to exporting countries. Persistently higher oil prices contribute to a decrease in oil revenues and an improvement in the balance of payments for oil-exporting countries. The shift in purchasing power or transfers of wealth leads to reduce the aggregate demand in oil-importing nations while at same time increases the aggregate demand in exporting countries of oil. Example of such discretionary income effect described by yellen, (2011) that the increase of oil prices reduces American income, because U.S. dependency on imported oil is high and result much of income are shifted abroad, thus higher oil prices have a declining effect on consumers spending. This indicates, higher oil price depreciates terms of trade of the importing countries of oil (Dohner, 1981).

Now we are going to discuss what will be the effect of rising oil prices that resulted from oil demand shocks. The empirical evidence from decomposed real oil price models, e.g. Peersman and Robays, (2009, 2012) find that higher oil prices caused by oil demand or aggregate demand shocks driven by strong growth in global REA leads to a temporary rise in output or economic activity. Kilian, (2009) and Kim and Vera, (2017) find that the output temporally increases and then drop after a certain time in response to oil demand shocks. Baumeister and Hamilton, (2019) argued that the oil price goes up caused by higher oil demand do not reduce the U.S output. Cashin et al. (2014) invention that demand driven increase of oil price have positive effect on real output. Cunado et al. (2015) find that shocks in oil demand have a significant and positive effects, especially on output. So mostly decomposed oil price models in which some Litrature find temporary rise in output in response to oil demand shocks while another find permanent rise in output following oil demand shocks in oil importing countries. This means that the direct stimulating effect of global economic boom or higher global demand on the output of oil importing countries will dominate than the indirect effect of increase in oil prices (Kilian, 2009).

3.2. Sources of Oil Price Shocks and Inflation.

The empirical evidence from decomposed real oil price models highlighted that the real oil price goes up driven by the three main sources generate inflationary pressure in the economy. Supply shocks driven oil prices cause permanent rise in inflation (Peersman & Robays, 2009). While such shocks have little effect on consumer prices (Kilian, 2009). Oil demand driven rise of oil prices have very strong positive effect on inflation (Peersman & Robays, 2009; Cashin et al., 2014; Kilian, 2009; Kim & Vera, 2017; Cunado et al., 2015). Finally, oil specific demand driven rise of oil prices also generate inflationary pressure in the economy (Kilian, 2009; Kim & vera, 2017). In support of these argument all the three shocks generate inflationary pressure in the economy.

Now we are going to provide a theoretical link for how or through which channel, higher oil prices cause the inflation driven by the three structural shocks. Rotemberg and woodford, (1996) argued that increase of oil prices affect the domestic economy through negative supply shock or decrease the aggregate supply of an economy. So, when the domestic supply of production will decline then it led to generate inflationary pressure in the economy. Second, oil price rises can directly generate inflationary pressure in the economy because the oil-based products can be seen as an important component of CPI and also can directly increase the consumer prices through higher imported goods prices as well as petroleum products in consumption basket. Third, the effect of declining in purchasing power due to rise in the prices of oil, the consumers can demand for higher wages, firms can pass the burden of higher cost through selling prices (Galesi & Lombardi, 2009).

3.3. Sources of Oil Price Shocks and Stock Prices.

Kilian and Park, (2009) was the first who used decomposed real oil price model by analyzing the three structural shocks effect on the stock prices. Their results highlighted that oil price rises in response to shocks in oil supply have insignificant effect on U.S stock prices. The shocks to oil demand have positive affect on stock prices for the first 11-months but its partially significant only for the first 7-months. while the precautionary demand shocks lower the stock prices of U.S significantly over the impulse response horizon. Gupta and Modise, (2013) They find that the shocks to oil demand driven oil prices lead to increase the stock returns while oil price rises that resulting from shocks to oil production and oil stocks lead to reduce the stock prices. Mohn and Misund, (2009) and Wang et al. (2017) also reported that aggregate demand shocks driven oil prices lead to increase the stock returns while oil price rises that resulting from shocks to oil supply as well as oil specific demand or oil stocks lead to reduce the stock prices. In support of these arguments the oil supply as well as oil market specific demand shocks driven oil prices leads to

reduce the stock prices while oil prices rise following oil demand shocks leads to improve the stock prices.

The possible theoretical link that why oil supply as well as oil market specific demand shocks driven oil prices leads to reduce the stock prices. The reason for the decline in stock prices may be due to rising oil prices result in increase the cost of production of listed companies in stock market, therefore the higher cost of production reduces the profit of firm which in turn decrease the stock prices. Second, demand for energy is relatively inelastic (Kilian, 2008). So, in case of inelastic demand for oil, increase of oil prices will generate inflationary pressure into the economy which decrease the demand for firm products. Thus, the reduction in firm sales and profits cause the stock prices to be lower.

While another side, mostly Litrature argued that oil price rises caused by shocks to oil demand driven by growth in worldwide economic activity positively affect the stock prices. This means that in case of international increase in oil demand driven by growth in economic activity around the world may be beneficial for most listed companies in stock exchange. The direct effect of strong growth in economic activity worldwide will dominate than indirect effect of raising oil prices due to higher oil demand.

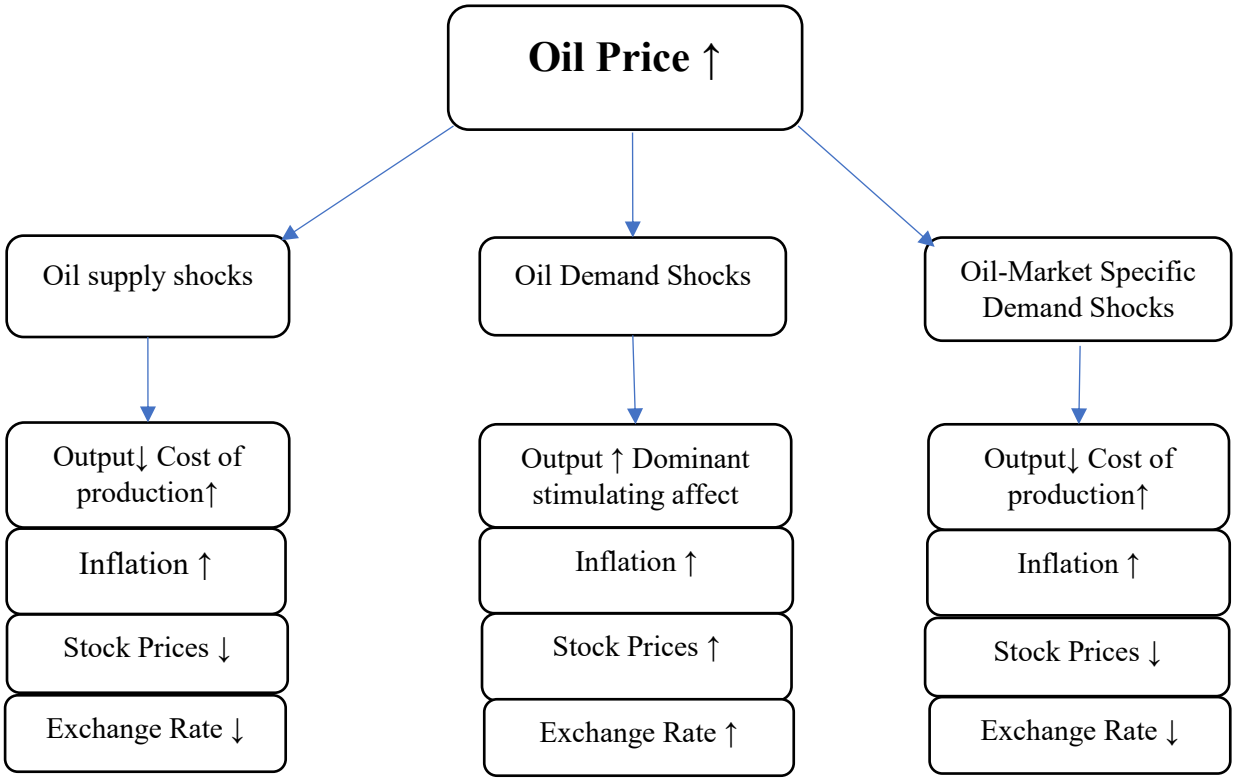
3.4. Sources of Oil Price Shocks and Exchange Rate.

Mostly decomposed real oil price model highlighted that, shocks to oil supply and precautionary demand, depreciate the real exchange rate. Meaning that domestic currency depreciates in terms of foreign currencies (Chisadza et al., 2016; Cunado et al., 2015). while the oil price goes up caused by shocks to oil demand driven by worldwide economic activity appreciates the exchange rate (Chisadza et al., 2016). The reason for the depreciation of exchange rate due to OP shocks caused

by shocks in supply and precautionary demand can be due worsen trade balance of oil importing countries, which can put pressure on the domestic currencies to depreciates. Improvement in the terms of trade means that smaller volume of the exports will be needed for the payment of quantity imports. In case of rise in oil prices more exports would be needed to offset higher burden of the rising import bills. Through this channel the higher oil prices can depreciate the domestic currency.

While some Litrature highlighted that the increase in oil prices caused by oil demand shocks driven by worldwide strong growth in economic activity leads to appreciation of real exchange rate, means improvement in the domestic currency. The reason for this appreciation may be due to expansion of worldwide economic activity, which can lead to increasing demand for the industrial commodities as a results higher exports would be expected from oil importing countries and can appreciates their exchange rate.

Figure: 3.1, Transmission Channels of Sources of Oil Price Shocks



3.5. Hypothesis of the Study.

In the light of earlier discussion in which we provide the detail about what will be each variable response to the three structural shocks in sport of existing literatures and by providing the theoretical link that how or through which channel the sources of OP shocks can affect the output, inflation, stock prices and exchange rate, thus considering this discussion we assume to test the following alternative hypothesis.

$H_1$1: The effect of OP shocks driven by oil supply shocks and oil market specific demand shocks are negative while the effect of OP shocks driven by oil demand shocks is positive on the industrial production/ output of pakistan.

$H_1$2: The effect of OP shocks that resulted from oil supply shocks, oil demand shocks and oil market specific demand shocks are positive on the consumer price inflation of pakistan.

$H_1$3: The effect of OP shocks caused by oil supply shocks and oil demand shocks are negative whereas the effect of OP shocks caused by oil demand shocks is positive on the stock prices of pakistan.

$H_1$4: The effect of OP shocks determined by oil supply shocks and oil market specific demand shocks are negative while the effect of OP shocks determined by oil demand shocks is positive on the real exchange rate of pakistan.

Chapter: 4

Data and Methodology

4.1. Introduction.

The chapter is based on the methodology used by the present study for the purpose to firstly decompose the real oil price fluctuations or to identify the main sources of the OP shocks and then to explore the effect of each identified source of OP shocks on output, inflation, stock prices and exchange rate of pakistan. The section 4.2 will describe data and variables then in subsequent section 4.3 we will present the methodology for how to use the exclusion restrictions as in Kilian, (2009) in the SVAR Model to identify the main determinants of OP shocks through 2020 and to present the second part of the methodology that how output, inflation, stock prices and exchange rate react to sources of OP shocks.

4.2. Variables and data Discerption.

The section will define the variables and have to provide a brief description on the data used by the study for empirical analysis of the determinants of real OP shocks and its macroeconomic effects.

4.2.1. Defining the Variables.

The study objective is to identify the key determinants or sources of OP shocks and then to examine the effect of each identified source of OP shocks on our variables of interest. The crude oil prices are determined in the world oil markets. The most influential approach to classify the key components of real OP shocks developed by Kilian, (2009). According to this approach there are three main sources or determinants of OP shocks such as oil supply, demand, and oil specific, demand shocks. Kilian, (2009) defined these three structural shocks in the following manner.

1) Oil supply shocks.

Shocks to current physical availability of crude oil production or shocks to global crude oil supply.

2) Oil demand or aggregate demand shocks.

Shocks to current crude oil demand caused by global business cycle fluctuations or shocks to global industrial commodities demand including crude oil driven by fluctuations in the global real economic activity.

3) Oil Market specific or precautionary demand shocks.

Shifts in oil Precautionary demand due to increased uncertainty about future shortfalls of oil supply. The terms oil specific and precautionary demand shocks can be used interchangeably. Precautionary demand result from high uncertainty about future shortfalls of oil supply relative to oil demand. precautionary demand reflects convenience yield from having access to oil inventory holdings that can help as insurance against the interruption of crude oil supplies. Such disruption will arise due to unexpected growth of oil demand or due to unexpected decrease of oil supply or because of both.

To identify these three key determinants or sources of oil price shocks, three variables' data are needed such as crude oil production (COP) data for oil supply shocks, real economic activity (REA) data for oil demand shocks and data of the real price of oil (RPO) itself for oil specific demand shocks.

Crude Oil Production (COP).

The oil supply shocks has been studied in the most influential literatures based on global COP data. We transform the world COP into natural log and then compute difference of the series.

Real Economic Activity (REA).

To capture oil or aggregate demand shocks Kilian, (2009) developed an index of global RAE which measure those components of worldwide REA that can derives industrial commodities demand in international markets. To measure the worldwide REA this index is based on dry cargo single voyage ocean freight rates that can capture fluctuations of industrial commodities demand in the global business markets. The further detail about the construction of this monthly index found in Kilian, (2009) but however, Hamilton, (2019) criticized this index by arguing that, the index can be incorrect because of unintentional log transformations. That is why the correct version of this index purposed by Kilian, (2019) and argued that the problem with this index highlighted by Hamilton is a result of consequence coding mistake and if once the error in coding is corrected by removing one of the log transformations, then the Hamilton critique will not remain valid, and the index can be used as originally intended. Kilian, (2019) further showed that, the results obtained based on the corrected index have only slight difference to the results obtained based on original index, that is why when replacing the index, the results from Kilian, (2009) and related studies will remain unchanged.

Real Price of Oil (RPO).

We can capture the oil market specific demand shocks by having control for both oil supply and aggregate demand shocks in SVAR model to identify oil market specific component of demand as residual and this residual can effectively represent the oil market specific demand shocks. If once we obtained the oil supply and demand shocks contribution in real oil price fluctuations, then the remining fluctuations of oil prices can be due to residual shocks which can effectively represents oil specific demand shocks. Following Kim and Vera, (2017) We transform the real oil price series into natural log and then deflate it with U.S CPI and then remove the mean.

Macroeconomic Variables

Our second objective is to examine the effect of each identified source of OP shocks on output, inflation, stock prices and exchange rate of pakistan.

1) Gross Domestic Product (GDP)

GDP can be defined as the market value of all final goods and services produced within a year in a country. It is one of the most important and primary indicators used to measure the conditions of an economy. Following Arshad and Ahmed, (2011) we used Economic Activity, Industrial Production, Manufacturing, Index as a proxy for Gross domestic product because the monthly as well as quarterly data of pakistan GDP are not available for our selected sample period. For industrial production (IP) we take log difference multiplied by 100 and it is denoted by Δy_t.

$$\Delta y_t = lny_t - lny_{t-1} * 100$$

2) Inflation.

Inflation can be defined as the increase in general price level of a country. Two measures of inflation widely used in the literature of OP shocks which is wholesale price index (WPI), the consumer price index (CPI). The consumer prices have strong link with oil prices. The study used CPI as measure of inflation. we take log difference of CPI and then multiplied by 100. Which is denoted by $\Delta\pi_t$.

$$\Delta\pi_t = ln\pi_t - ln\pi_{t-1} * 100$$

3) Stock Prices.

A stock price can be defined as a reflection of company's value that how much investors are willing to pay for a share of company.[1] The study used Karachi Stock Exchange (KSE 100) Index as a measure of aggregate stock prices. This index provides information to the investors that how the pakistan stock market is performing. We represent the stock prices in percent growth rate by taking log difference multiplied by 100. Which is denoted by ΔSP_t.

$$\Delta SP_t = lnSP_t - lnSP_{t-1} * 100$$

4) Exchange Rate.

Exchange rate is the price of one currency expressed in terms of another currency.[2] There are several measures of exchange, such as domestic currency per U.S dollar, Nominal Effective Exchange Rate (NEER) and Real Effective Exchange Rate (REER) etc. in the present study we used Real Effective Exchange Rate (REER), because it is constructed as a measure of domestic currency value against weighted average of various foreign currencies divided by CPI. The increase in the REER reflects appreciation of domestic currency while decrease reflects depreciation of domestic currency. We calculated REER as a log difference multiplied by 100 And it is denoted by $\Delta REER_t$.

$$\Delta REER_t = lnREER_t - lnREER_{t-1} * 100$$

[1] Internet Source
[2] Source: International Monetary Fund (IMF)

4.2.2. Data Description.

The section describes a brief description about data used by the present study for empirical analysis of identifying determinants of OP shocks and its macroeconomic effects. To identify the key determinants of OP shocks, three variables' data are needed such as COP data for oil supply shocks, global REA data for oil demand shocks and data of RPO itself for oil specific demand shocks. The study used monthly data on these three variables from Feb-1974 to Sep-2020.

We use updated data on COP, REA and RPO from the sources cited by Kilian, (2009). The data of world COP and on the series of RPO (based on refiner acquisition cost of imported crude oil) has been taken from U.S. Energy Information Administration (EIA). For the measure of global REA, we use latest and corrected version of Monthly index of global REA based on dry cargo bulk freight rates developed by Kilian, (2009) and updated as well as corrected by Kilian, (2019) and the data on this index has been taken from their website[3].

To investigate the sources of OP shocks impacts on Output, inflation, Stock prices and exchange rate of pakistan. We obtained data on output, inflation, and exchange rate from International Monetary Fund's International Financial Statistics (IFS) while on stock prices we retrieved it from Pakistan stock exchange.

[3] We retrieved the corrected and updated monthly index from the below link.

https://sites.google.com/site/Ikilian2020/research/data-sets.

4.3. Decomposition of Real Oil Price and its Macroeconomic Effects.

In this section we will present the two parts of our methodology for, (1) how to decompose the real OP shocks by using SVAR model based on exclusion restrictions and (2) To present the methodology for how to estimate separately the effects of each identified structural shocks on variables of interest in the context of pakistan.

4.3.1. The Structural Vector Autoregressive (SVAR) Model.

The section will represent the first part of the methodology used by the present study for the decomposition of oil price fluctuations purposed by Kilian, (2009). This decomposition can have important implications for, how policy makers, economist, and even general public should think about the fluctuations of oil prices. As in the Kilian, (2009) we have to estimate the VAR model that based on three variable and these variables consists of monthly data such as $x_t = (\Delta COP_t\ , REA_t\ , RPO_t)$. In this vector the ΔCOP_t represents the percent change in global crude oil production, and REA_t represents the monthly index of world real economic activity and RPO_t denotes the real price of oil. So, in order to determine the contributions of each structural shock in the real oil price fluctuations and to see how, the economy react to them, to do that we have to estimate the SVAR model based on exclusion restrictions. Consider the general form of SVAR model.

$$A_o x_t = \alpha + \sum_{i=1}^{24} A_i\, x_{t-i} + \varepsilon_t \qquad (1)$$

Where x_t is the (3×1) vector of observed variables such as $(\Delta COP_t\ , REA_t\ , RPO_t)$. And the α represents (3×1) vector of intercept terms, and $A_i, i = 1, \ldots, 24$ is the (n × n) matrix of lagged coefficients. and A_0 can be denoted as (3×3) matrix of the contemporaneous coefficients. Finally,

the ε_t indicates (3×1) vector of serially and mutually uncorrelated structural shocks. Since the structural shocks are generally not directly observable, but under appropriate conditions, it can be recovered from the reduced-form representation of equation (1). So, we have to estimate the reduced-form VAR model consistently by OLS and then the resulting estimate are used to construct the representation of SVAR model. To do that we have to pre-multiply both sides of equation (1) by A_o^{-1} to derive the reduced form representation of equation (1).

$$A_o^{-1}A_o x_t = A_o^{-1}\alpha + \sum_{i=1}^{24} A_o^{-1}A_i\, x_{t-i} + A_o^{-1}\varepsilon_t$$

$$x_t = \beta + \sum_{i=1}^{24} \beta_i\, x_{t-i} + e_t \qquad (2)$$

Where

$$e_t = A_o^{-1}\varepsilon_t \qquad (3)$$

To determine each structural shock contribution in the variations of real oil price or to recover the structural shocks, parameters from the reduced-form VAR model. Kilian, (2009) obtained the identification by assuming that A_o^{-1} has a recursive structure because of the reduced form errors decomposed by him according to $e_t = A_o^{-1}\varepsilon_t$. So, then the system can be represented as follows.

$$e_t \equiv \begin{pmatrix} e_t^{\Delta COP} \\ e_t^{REA} \\ e_t^{RPO} \end{pmatrix} = \begin{bmatrix} a_{11} & 0 & 0 \\ a_{21} & a_{22} & 0 \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{pmatrix} \varepsilon_t^{oil\ supply\ shock} \\ \varepsilon_t^{aggregate\ demand\ shock} \\ \varepsilon_t^{oil-market\ specific\ demand\ shock} \end{pmatrix}$$

Following Kilian, (2009) The identifying restrictions on A_o^{-1} can be motivated as follows.

1. "The crude oil supply within the same month will not response to innovations in oil demand." This exclusion restriction may be relevant in practice with the behavior of oil producers because

the frequently oil production changes are costly that is why the oil producers set the production target based on expected trend growth of oil demand and it is not revise by oil producers in case of high frequency changes in oil demand. The high frequency changes in the growth of demand are not easy to detect because their detection require the data based on long time span so this reason can suggest the production plan of oil producers that it will be changed infrequently. This view is consistent with Saudi oil company (state owned) which make the forecasts of the oil demand for oil production plan only once in the whole year. Thus, due to costs of adjusting crude oil production, in practice the countries that are oil producers will be slow to react for shocks in oil demand in the short run. This shows vertical oil supply curve because within the short run oil supply will not response to any oil demand shocks, so the supply curve of crude oil in the short run will be vertical and it will be shift vertically to the left due to exogenous cuts in oil production caused by exogenous events, thus we can say that the oil supply shocks are exogenous.

2. “The oil demand will response to Contemporaneous oil supply as well as aggregate demand shocks”. The oil demand curve will be downward slope and according to this exclusion restriction, the oil demand curve will be shift due to both oil demand shocks such as aggregate demand as well as oil-market specific demand shocks and it will move along the curve due to supply shocks.

3. The oil stocks (oil precautionary demand) will response to all the three shocks, oil supply, demand, and oil-market specific demand shocks it reflects variations in the oil price expectations and uncertainty on how the crude oil demand and supply will evolve in the future. The oil specific demand shocks will shift both the vertical crude oil supply and the downward oil demand curve.

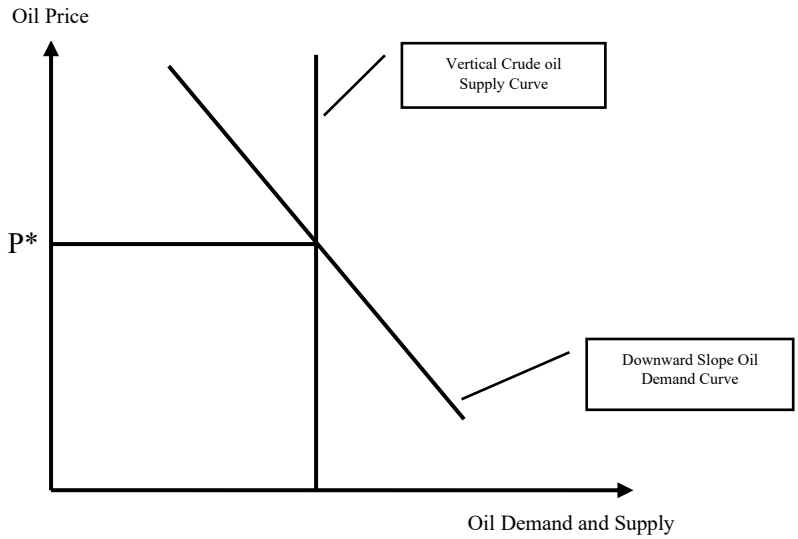


Figure 4.1: Short-run equilibrium model of crude oil market.

4.3.2. Macroeconomic Effects of Sources of Oil Price Shocks.

Following Kilian, (2009), In this section we will presents the second part of our methodology used for to estimate the effects of structural oil shocks identified by model (1) on GDP, inflation, Stock prices and exchange rate in the context of pakistan. However, the Monthly structural VAR model (1) is estimated based on sample from Feb-1974 to Sep-2020, but the data as per the given sample are available only for output and inflation. The data on stock prices and exchange rate due to unavailability for the full sample we take from Jan-1995 to Sep-2020. That is why the analysis we proceed into two steps, in the first step we have use the sample from Feb-1974 to Sep-2020 for estimation of structural VAR model to see the impacts if identified structural oil shocks on output and inflation then in the second step having identified the three structural shocks from 1974 to 2020, we can use these identified shocks from 1995 to 2020 for to see the reaction of stock prices and exchange rate to the oil supply and both demand shocks.

4.3.2.1. The Effect of Sources of Oil Price Shocks on Output and Inflation.

in this step we have to present the methodology for to estimate the effects of structural oil shocks identified by model (1) based on sample from feb-1974 to Sep-2020 on output and inflation. however, there may be a problem to estimate such effects because we have used the industrial production index as a proxy for Real GDP but the data on this index are available on quarterly basis, if we estimate structural VAR model such as equation (1) based on quarterly data instead of monthly then Kilian, (2009) argued that the identifying assumptions will not be credible. To cope with this problem in the first stage we have to identify the main sources of OP shocks from the monthly Structural VAR model such as equation(1) then having these identified structural shocks there is necessary to be transformed it into quarterly shocks by averaging the monthly structural shocks into quarters, then we have to use quarterly structural shocks and to see how the output and inflation react to them[4], therefore the general form of quarterly representation for each structural shock can be found as;

$$Q_{jt} = \frac{1}{3}\sum_{i=1}^{3} \varepsilon_{j,t.i} \qquad j = 1,2,3$$

Where $\varepsilon_{j,t.i}$ denotes the estimated residuals for j^{th} structural shock in the i^{th} month of the t^{th} quarter of the sample. Kilian, (2009) assumed that there will be no feedback from the domestic economy to quarterly structural shocks in the same quarter which indicates that the quarterly structural shocks can be treated as predetermined. Kilian and Vega, (2011) demonstrated that, this assumption is consistent with daily U.S data on macroeconomic news which do not predict changes in oil prices within a month while on the other hand it can predict changes in the stock or other

[4] However, the data on CPI are monthly but to compute the response of CPI to the three structural oil market shocks along with output then it is necessary to hold balance by using quarterly data of CPI.

assets returns. So, we can say that the quarterly structural shocks are predetermined with respect to pakistan economy, which means that there will be no reverse causality from pakistan macroeconomic aggregates to the quarterly structural shocks or real oil prices because the pakistan economy is small and have no influence in the international oil market. Thus, we can investigate how the pakistan GDP and inflation react to these quarterly structural shocks such as oil supply, Demand and oil market specific demand shocks based on the following regressions.

$$\Delta y_t = \alpha_j + \sum_{i=0}^{12} \beta_{ji}\, Q_{jt-i} + u_{jt} \qquad j = 1,2,3 \qquad (4)$$

$$\Delta \pi_t = \gamma_j \sum_{i=0}^{12} \phi_{ji}\, Q_{jt-i} + \mu_{jt} \qquad j = 1,2,3 \qquad (5)$$

The two-regression equation from (4) to (5) where β_{jh} , ϕ_{jh}, represents the impulse response coefficients at horizon h, respectively. we set the impulse response horizon up to 12 quarters. And the u_{jt} , μ_{jt} denotes the errors which are potentially serially correlated. The possible existence of serial correlation in the error term is addressed using block bootstrap methods to conduct inference on the response estimates indicated by models (4) to (5).

4.3.2.2. The Effect of Sources of Oil Price Shocks on Stock Prices and Exchange Rate.

This step will be used for how stock prices and exchange rate react to the three structural shocks identified from Monthly Structural VAR Model (1) based on sample Feb-1974 to Sep-2020. If once we obtained the structural shocks from model (1) then having these identified shocks, we can use it from 1995 to 2020 for to see the response of stock prices and exchange rate to the identified shocks. Here we do not have the problem of quarterly data, both variables such as stock prices

and exchange rate are available at monthly frequency, we can directly estimate the response of stock prices and exchange rate to the monthly structural oil market's shocks.[5]

$$\Delta SP_t = \delta_j \sum_{i=0}^{24} \psi_{ji}\, \varepsilon_{jt-i} + \omega_{jt} \qquad j = 1,2,3 \qquad (6)$$

$$\Delta REER_t = \delta_j \sum_{i=0}^{24} \varphi_{ji}\, \varepsilon_{jt-i} + \epsilon_{jt} \qquad j = 1,2,3 \qquad (7)$$

The regression equation from (6) to (7) where ψ_{jh} and φ_{jh} represents the impulse response coefficients at horizon h respectively and, it is set to be 24 months. To cope with the possible presence of serial correlation in the errors ω_{jt} and ϵ_{jt} the results obtained based on block size 4 and 20000 bootstrap replications.

[5] The assumption will be also hold that there will be no reverse causality from pakistan macroeconomic aggregates to the monthly oil supply and demand shocks.

Chapter: 5

Results and Discussion

The chapter will consist of four main sections, the first section 5.1 is about the results of unit Root test and lag selection. The second section 5.2 provides graph of the variables and summary statistics to have basic understanding about the data. In section 5.3 we have to interpret and discuss the results regarding sources of the OP shocks identification via impulse responses, variance decomposition and historical decomposition. In the final section 5.4 we will discuss the results of the effects of the identified sources of OP shocks on output, inflation, stock prices and exchange rate of pakistan.

5.1. Results of Unit Root Test and Lag Selection

Table 5.1 indicates the results of unit root test which shows all the variables are non-stationary at level except only for REA which is stationary at level because this index by construction is detrended. More specifically the REA is stationary at level while the remaining variables such as COP, RPO, IP, CPI, SP and REER are I (1). However, CPI is stationary by taking their first difference with varying level of significant. Following Kilian, (2009); Kim and Vera, (2017) our analysis used the REA with level form and the RPO with deviation from mean while the COP series is used by taking log difference (See Model 1 in section 4.3.1). And the remaining country specific variables are used by taking log differences (See regression equations 4, 5, 6 and 7 in section 4.3.2).

Table 5.1: Results of Unit Root Test

	Augmented Dickey-Fuller (ADF) Test	
Oil-Market variables	Level	First Difference
COP	0.920	–4.842***
REA	–3.445***	–7.070***
RPO	–0.920	–11.057***
Country-Specific variables	Level	First Difference
IP	–0.040	–7.568***
CPI	1.111	–3.186*
SP	–0.006	–17.072***
REER	–0.856	–13.873***

Lag Selection Criteria

The standard lag selection criteria such as HQC and AIC suggest using 2 and 8 lag respectively. However, this study used the Monthly SVAR Model based on 24 lag by following Kilian, (2009) to achieve long cycle of the data.

Table 5.2: Lag Selection Criteria

Lags	HQC (Hannan-Quinn Criterion)	AIC (Akaike Criterion)
0	40.675	40.665
1	30.395	30.358
2	30.015*	29.951
3	30.018	29.926
4	30.050	29.930
5	30.072	29.924
6	30.096	29.921
7	30.138	29.935
8	30.151	29.920*
9	30.194	29.936
10	30.230	29.945
11	30.281	29.967
12	30.302	29.961

5.2. Summary Statistics and Graph of the Variables.

Table 5.3 shows basic summary of the data of variables used for the first part of our analysis about the decomposition of real oil price dynamics, for the sake to have basic understanding about the data of the three variable such as COP, REA and the RPO.

Table 5.3: Descriptive Statistics.

	COP	REA	RPO
Mean	66296.43	-0.009464	37.11011
Median	65373.25	-9.775000	27.35500
Maximum	84545.52	191.4200	127.7700
Minimum	49812.05	-158.7200	9.390000
Std. Dev.	9138.189	54.71590	26.94216
Skewness	0.235899	0.924682	1.318991
Kurtosis	1.855440	4.338815	3.773049
Jarque- Bera	35.76093	121.6267	176.3197
Probability	0.000000	0.000000	0.000000
Obs	560	560	560

The Time Series Graph of Variables.

The oil prices are determined in markets of crude oil, the key sources of the determination of oil price are oil supply and both demand shocks. From the graph 5.1 we can see the historical fluctuations in real oil price series caused by oil supply and demand shocks, however large oil price fluctuations are attributed to demand shocks. Causes of Historical OP shocks has been interpreted by different literatures by using the Kilian, (2009) framework and the same data, especially global real economic activity index, but these developments in Litrature still up to 2015. By using Kilian, (2009) framework and updated and corrected measure of global real economic activity with sample extension we can predict the recent derivers of oil price shocks. From the

graph we can see the sharp decline in real oil price at early 2016 can be due to negative aggregate demand shock, and more especially the recent decrease in real oil price started from Jan-2020 can be attributed mainly due to decrease in aggregate demand caused by slowdown in global economic activity due COVID-2019, and then the prices slowly move toward recovery due to sharp decline in oil supply. So, this is the results from plotting the data, and in the next section we have to provide proper results from decomposed oil price framework developed by Kilian, (2009).

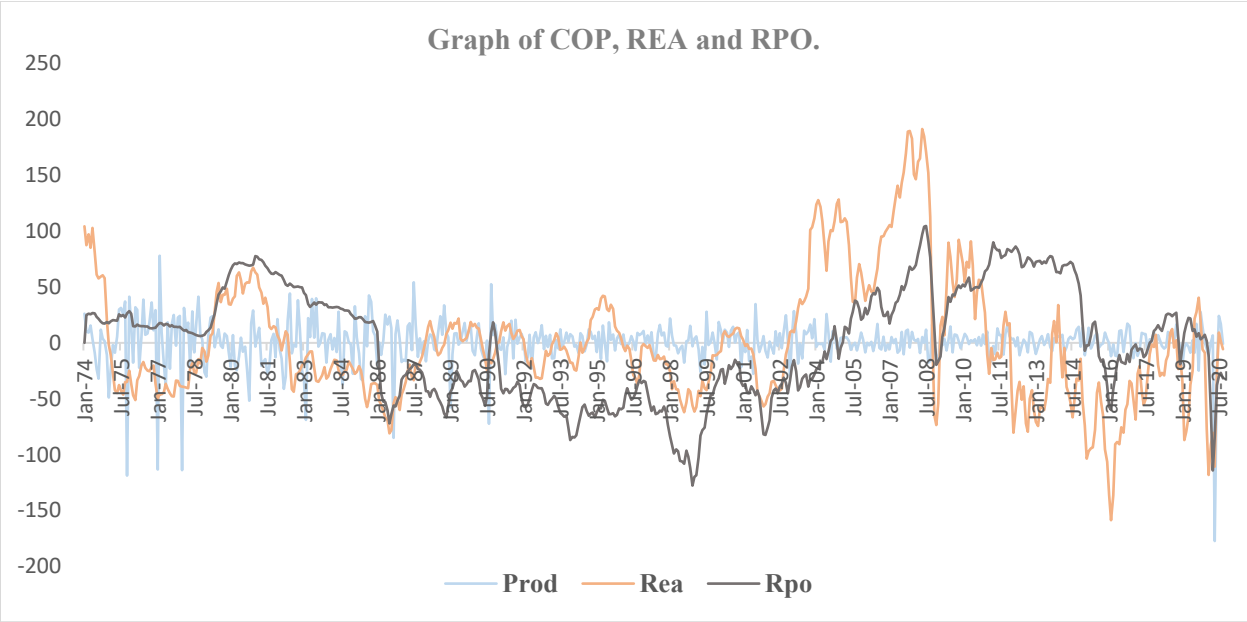


Figure 5.1: Time series plot of Variables

5.3. Empirical Results: Decomposition of Real Crude Oil Price.

The section presents the empirical findings estimated from model (1). For convenience, the section has been classified into four subsections. First, subsection 5.3.1 delivers the results regarding historical structural shocks evolutions to the dynamics of oil price. The second subsection 5.3.2, presents the results of structural shocks contribution in oil price determinations through impulse responses. The third subsection 5.3.3 is about the results of variance decomposition to show how much of the variations in real oil prices are explain by the three structural shocks. Finally, the last subsection 5.3.4, describes the results of historical contribution from each structural shock in oil price fluctuations through historical decomposition.

5.3.1. Quantifying Evolution of the Structural shocks.

Figure 5.2 plots historical pattern of each structural shocks estimated from model (1) through averaged the monthly structural shocks by year to improve the plot readability. From this graph we can observe that, at any point in time, the real oil price reacts to a combination of shocks and the composition where it is evolves over time. We have obtained some interesting results by extending the sample period to 2020. By Extending the sample and using corrected and updated version of monthly index of global REA purposed by Kilian, (2019) only have a slight difference compared to the original results of Kilian, (2009) through 2007.

The middle panel of figure 5.2, which shows historical evolution of aggregate demand shocks, starting from 2007 there is evidence of large negative aggregate demand shock in 2008, then this drop in aggregate demand equally recovered in 2009 and again negative aggregate demand shock occurred in 2010. The middle panel of Figure 5.2 can also show a positive aggregate demand shock in 2013, but it decreased significantly again in 2014, and then increased gradually through 2019. The top panel of figure 5.2 showing historical evolution of oil supply shocks, the years 2009 and

2014 associated with small positive and 2017 with negative shocks to oil supply. The oil supply shock does not show any significant changes in other periods after 2007. The last panel of figure 5.2 depicts the shocks of oil specific demand and it is related with a drop in 2008 and repeated increase through 2011. There is another evidence of drop in oil specific demand in 2015 and then its again recovered in 2016.

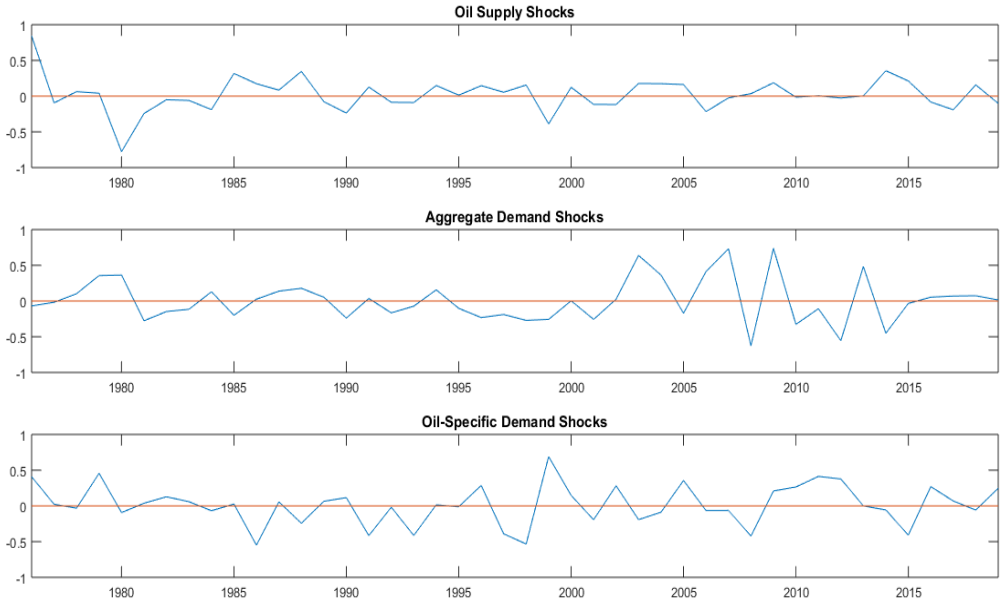


Figure 5.2: Historical Evolution of the Structural shocks, 1976-2020.

5.3.2. Impulse Response Analysis.

Figure 5.3 display the response of COP, REA and RPO to oil supply, aggregate demand, and precautionary demand shocks, to answer the question such as how much of the variations in real oil price are explain by shocks in oil demand and supply or how much the average contribution of the three structural shocks in real oil price. As in Kilian, (2009) and others we normalized the three structural shocks such that each structural shock will tend to raise the oil price. The maximum horizon of VAR impulse response estimates is set up to fifteen months.

The unanticipated oil supply reduction causes small but almost smooth increase in oil price over the impulse response horizon and based on one standard error confidence bonds it's statistically significant over the fifteen months. Second, shock in aggregate demand causes sharp increase in price of oil for the first three months then it's begin to decline at very small portion and again increases very slowly after 9 months and further drop occur after 14 months. So, the real oil price response to shock in aggregate demand is positive and statically significant over the impulse response horizon. Finally, precautionary demand shock causes immediate and sharp oil price increase for the first two months and then the response is large and positive and highly statistically significant however its decline slowly over the impulse response horizon. In summary, figure 5.3 results indicate that, timing as well as magnitude of real oil price response to the three structural shock may differ greatly. The aggregate demand (or oil demand) and precautionary demand shocks are the major contributor by affecting the real oil price while negative oil supply shock affect the real oil price but relatively small. This suggest that not all OP shocks are alike, because their causes affect the real oil price differently.

(Estimates with One and Two-Standard Error Bonds)

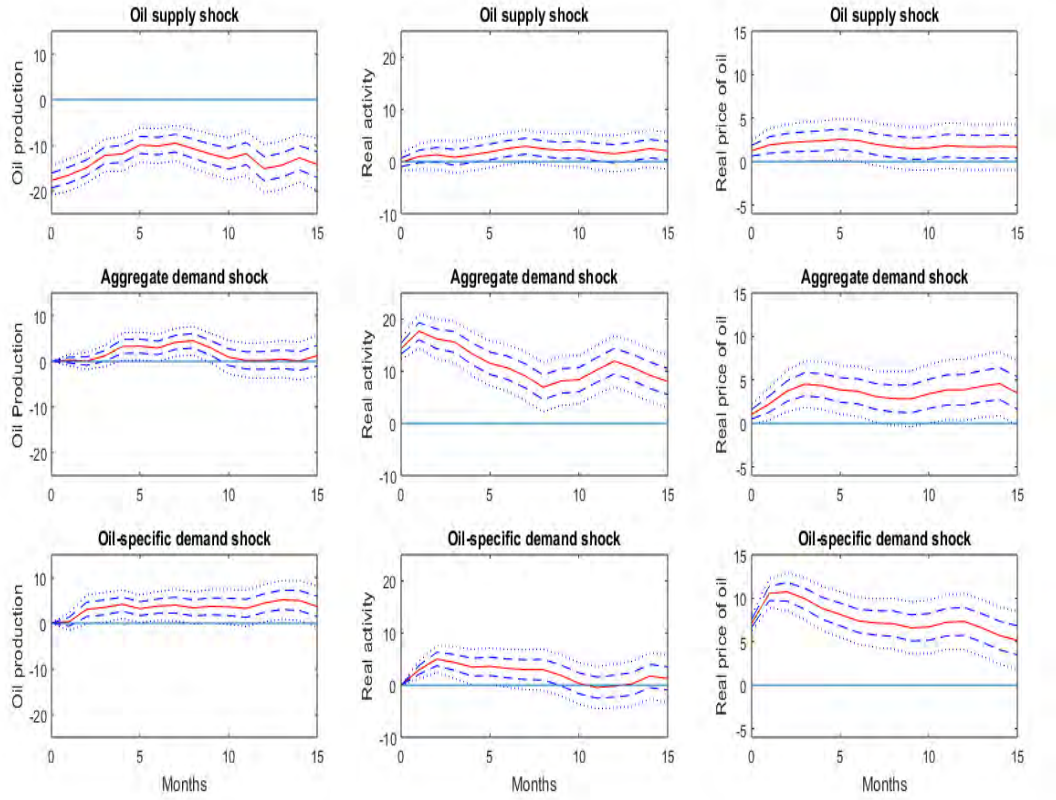


Figure 5.3: Responses to one standard deviation structural shock

5.3.3. Variance Decomposition (VD).

Besides the impulse response function (IRF), the variance decomposition (VD) or more precisely the forecast error variance decomposition (FEVD) also helps in interpretation of SVAR model and can confirm the results of IRF. The IRFs will indicate you the response of oil prices to the three structural shocks while, the VD reflect how much of the variations in real oil price are explained by the three structural shocks, and both describe average movements of the data.

Table 5.4 shows the FEVD for the oil price, to represent the three structural shocks percent contribution in oil price dynamics, or how much increase in real oil price due to the three structural

shocks. We focus on the horizons up to 36 months. Starting from oil supply shocks which contribute 2.95% in real oil price for the first month and then their contribution increases but relatively small up to 4% for thirty months. Second, the aggregate demand shocks, in short run their effect is negligible about 2% for the first month but with respect to time the shock in aggregate demand contribute importantly and their explanatory power increases up to 25.7% at 36 months horizon. Finally, the highest contributing element in real oil price fluctuations is the precautionary demand shocks itself, however the contribution of this residual shocks declines gradually with respect to time but still that is the major contributor by causing 70% variations in real oil price in the long run such as at 36 months horizon. Thus, the VD of real OP shocks mainly verifies the results of IRFs.

Table 5.4: Forecast Error Variance Decomposition for Shocks in Real Oil Price.
Present Contribution by the Structural Shocks in Real Oil Price at Horizon h.

Horizon (Months)	Oil Supply Shock	Aggregate Demand Shock	Oil Specific Demand Shock
1	2.9500	2.0753	94.9746
3	3.2231	6.4743	90.3026
6	4.4218	11.8706	83.7076
9	4.8850	12.7847	82.3304
12	4.7903	13.8631	81.3466
15	4.7541	16.1486	79.0973
18	4.9678	16.9876	78.0446
21	4.7680	18.7024	76.5295
24	4.4313	20.6891	74.8796
27	4.1642	22.4565	73.3793
30	4.0244	23.5215	72.4541
33	3.8623	24.7272	71.4105
36	3.7045	25.6842	70.6114

5.3.4. Historical Contribution of Structural Shocks in Real Crude Oil Price.

The IRFs and VD describe average movements of the data. To quantify how much will be a given shock effect on real oil price fluctuation at every given point in time, e.g., if we are interested wither oil demand shock cause 2007-08 oil price increase. So, this can be answer with the help of historical decompositions. Figure 5.4 and 5.5 illustrates each Structural shock contribution in variations of oil prices through historical decomposition. To better understand historically the structural shocks contribution in dynamics of oil price we plot the same historical decomposition of real oil price as in figure 5.4 with actual real oil price series in figure 5.5.

The oil price shock of 1978-80, in which oil price increased from 15$ in Nov-1978 to 35$ per barrel in Jul-1980. This oil price shock has been reacted to a combination of shocks. The major contribution in this increase associated with oil market specific demand shock throughout this period and especially in 1979. The aggregate demand shock also shows important role in this increase while oil supply shock shows minor role and has derived the real oil price after Jan-1980 to Oct-1980. In short, this increase of oil prices in 1978-80 was largely due to increase in oil market specific and aggregate demand for the crude oil, consistent with Barsky and Kilian, (2002) whose reported that this increase was mainly due to increase in oil market specific and aggregate demand after May- 1979 to April- 1980. In addition, Kilian and Murphy, (2014) argued that the speculative demand for oil was performed important role in rising crude oil prices in May 1979 to April 1980. The sharp decrease in real oil price following 1986 collapse of OPEC, this sharp decrease largely associated with drop in oil precautionary demand, and due to increase in oil production by Saudi Arabia. Kilian and Murphy, (2014) highlighted that, the sharp decrease of price in 1986 not only due to increase in oil production by Saudi Arabia but also due to a reduction in speculative demand for oil.

The sharp rise of real oil price in 1990 caused by Persian Gulf war of 1990-91, was resulted due to rise of oil precautionary demand rather than oil supply and aggregate demand shocks. The negative real oil price shock fallowing asian crisis of 1997-98, the contribution in this decrease there is evidence of continuous and large decrease in precautionary demand and continuous and small decrease in aggregate demand while oil supply shock has not played its role in this decrease, and again the recovery of this decrease started from Jan-1999 to Feb-2000 was also resulted due to recovery in oil precautionary demand rather than oil supply or aggregate demand shocks. So, by extending the work of Kilian, (2009) through 2020 with corrected version of monthly global REA index purposed by Kilian, (2019) the same conclusion as we have discussed has been interpreted in Kilian, (2009) of figure 5.4 from 1975 to 2007. Now by extending the sample period to 2020 yields interesting results.

The N-shap pattern in real oil price started from Jan-2007 to Nov-2009, this N-shap movement in real oil prices we separate into two categories. First, the oil price rise started from Jan-2007 to its peak in Jul-2008, was largely due to flow demand shock caused by global business cycle consistent with other literatures from empirical and theorical works whose found that this rise in price mainly explain by unexpected development of global economy, strong global demand, and demand for oil from emerging Asia (Hamilton, 2009; Kilian & Hicks 2013; Baumeister & Peersman 2013).

Second, the financial crises of 2008, demonstrate the V-shape pattern of oil price variations in 2008-09, started sharply decline from $128 per barrel in Jul-2008 to $36 per barrel in Dec-2008 and then recovered to $74 per barrel in Nov-2009. The reasons behind this trend there is evidence of drop in aggregate demand and oil precautionary demand due to a major global recession. The drop in oil market specific or precautionary demand for the crude oil has contributed to this decrease more than aggregate demand shock. So thus, the precautionary and aggregate demand

recovered in 2009 and stabilized the price to somewhat prevailing 2007 which documented near to $74 per barrel in Nov-2009. Our result also almost consistent with (Kilian & murphy, 2014).

The oil price collapse of 2014-15 which was fell from $100 in Jun-2014 to $45 per barrel in Jan-2015. The contributions in this decrease there is evidence of strong drop in oil precautionary demand and due to drop in aggregate demand that started earlier and due to small increase in oil supply. The further collapse in real oil price in 2016 started decline from $59 per barrel in Jun 2015 to $27 per barrel in Feb-2016. The result from figure 5.4 show that, the main reason for this declined was the aggregate demand shock due to drop-in global REA caused by global recession or due to drop in industrial commodities demand including crude oil (the reduction in demand for industrial commodities causing to the reduction in demand for oil because oil as an input into industrial production). And the second major reason of the decline in real oil price in 2016 was the drop in precautionary demand for oil, while supply shock does not show any significant role in Feb-2016 oil price declined. The decline in real oil price to some extent recovered in Jun-2016 to &44 per barrel due to recovery in both oil demand shocks. The negative oil price shock in late 2018, there is evidence that this decrease in oil prices was also due to drop in oil aggregate and oil precautionary demand.

Finally, the recent fall in oil prices, following COVID-19 in which the real oil price fell from $57 per barrel in Dec-2019 to $17 per barrel in Apr-2020. This oil price decline was primarily due to sharp decrease in aggregate demand caused by slowdown in global economic activity due to COVID-19 and then due to sharp fall in oil precautionary demand. The prices of oil slowly moved toward recovery started from $22 per barrel in May 2020 to $41 in Aug-2020. The reasons for this recovery are primarily due to a sharp fall in the production of oil-by-oil producers in order to

stabilize oil prices, and again to some degree due to recovery of oil aggregate and oil precautionary demand.

To summarize the figure 5.4, the shocks in oil prices, historical contribution by oil supply shocks play less important role relative to other two shocks (first panel of figure 5.4). The historical contribution from oil demand shocks in oil price fluctuations are important (second panel of figure 5.4). The oil-market specific demand shocks experiences with significant effect on oil price variations (third panel of figure 5.4). Both oil demand shocks can be considered as a major derivers of OP shocks. Thus, the evidence from figure 5.4 shows important differences in the relative contribution of the three structural shocks to oil price changes especially at specific time, so this means that not all OP shocks are alike, that is why the decomposition of real oil prices have important implications for their macroeconomic effects.

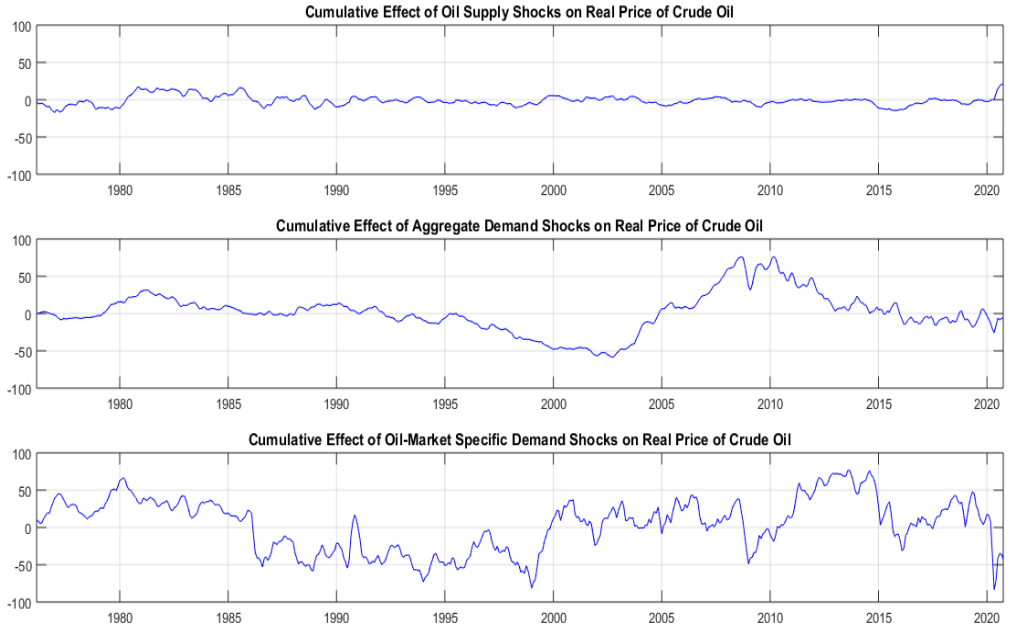


Figure 5.4: Historical Contributions of Structural Shocks in Real oil Price.

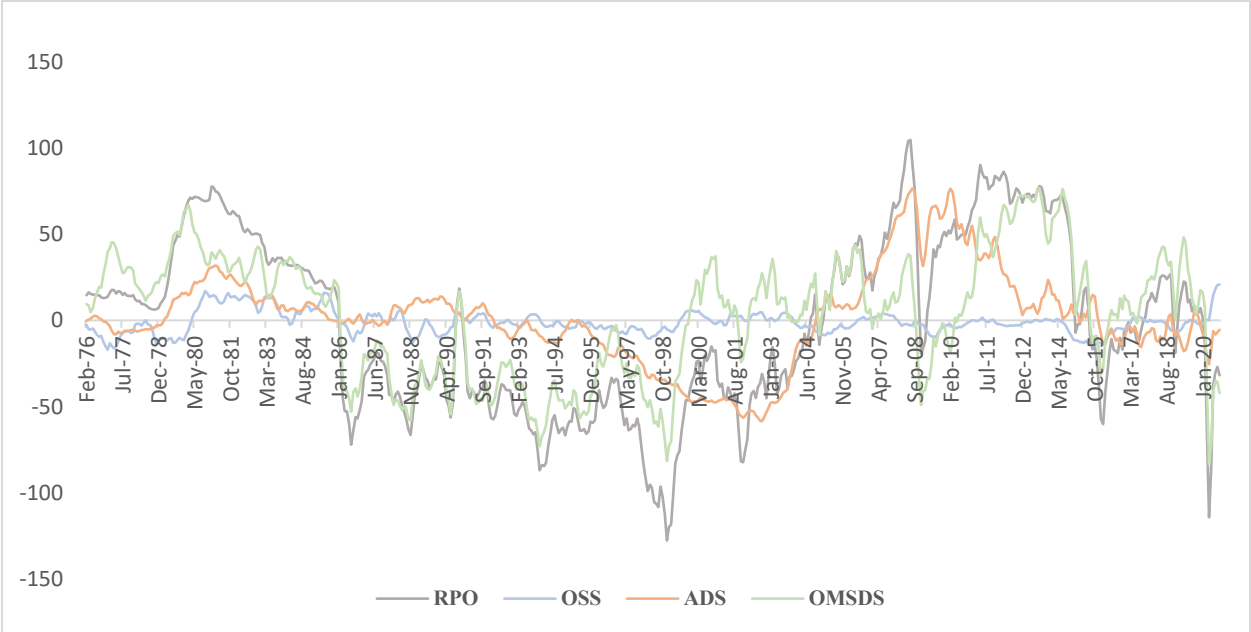


Figure 5.5: Historical Contributions of Structural Shocks in Real oil Price.

5.4. Macroeconomic effects of Sources of oil Price (OP) shocks.

This section describes the results regarding macroeconomic effects of the components of OP shocks, or more specifically to assess how each of the three sources of OP shocks affect Pakistan's Output, Inflation, Stock prices and Exchange rate. We have identified these three sources of real OP shocks from Monthly Structural VAR Model based on sample Feb-1974 to Sep-2020. The sources of OP shocks impact on the four variables we have estimated from equations (4), (5), (6) and (7) in section (4.3.2). The results regarding macroeconomic effects of structural oil shocks further have been classified into two subsections. The main purpose of this classification because of unavailability of data on stock prices for the sample (Feb-1974 to Sep-2020) through which we have identified the three structural shocks. That is why in section (5.4.1) we present the results of the effect of oil shocks on output and inflation that has been estimated through monthly structural VAR model based on sample feb-1974 to sep-2020 because the data on output and inflation are available as per the chosen sample through which we have identified the oil shocks. The section (5.4.2) describes the results regarding the response of stock prices and exchange rate to the three oil shocks that has been computed by using oil shocks from 1995 to 2020 instead of 1974 to 2020 because of availability of data on stock prices and exchange rate from 1995 to 2020. However, the exchange rate data are available for the chosen sample, but it is mostly constant at the beginning of the sample that is why we also used it from 1995 to 2020 to balance it with stock prices.

5.4.1. The Effect of Sources of Oil Price Shocks on Output and Inflation.

Figure 5.6 shows the IRFs of output and inflation to the three structural shocks. The maximum horizon of impulse responses is set up to 12 quarters. The plots in this figure shows the cumulated responses based on point estimates with one and two standard error bonds. The result from this figure shows there are important difference in how the three structural shocks underlying real oil

price affect output and inflation of pakistan. First starting from oil supply shock, figure 5.6 first row indicates that the crude oil supply disruptions, which raises the real oil price, shows negative affect on output for the three years but this affect is short lived and consistently repeated at all horizons. So, the negative response of output to oil supply shock is short lived and its repeatedly statistically significant for respective quarters within the three years. This result is in line with Peersman and Robays, (2009).

In addition, the response of inflation to negative supply shock is positive over the impulse response horizon except for quarters 11-12, however the positive inflation response to negative supply shock is statistically significant only for the first quarter based on one standard error bonds. The result of the response of inflation to unanticipated negative supply shock is similar with the results of Peersman and Robays, (2012) in case of Japan, Spain, Canada while in case of other industrialized countries its does not. It is also consistent with Cunado et al. (2015) in case of Indonesia, and Chisadza et al. (2016).

The second row of figure 5.6 illustrate that, the aggregate demand expansion leads to a positive effect on output at all horizons, but this affect is also short lived and appears repeatedly over the impulse response horizon. The positive response of output to aggregate demand (or oil demand) shock is marginally significant only for first and fifth quarters within the three years based on one standard error bonds which is consistent with Peersman and Robays, (2009). In response to aggregate demand expansion the inflation increases significantly over the impulse response horizon. The response of inflation to aggregate demand expansion is positive and become very large at 12 quarter horizons by increasing continuously, and such response is highly statistically significant over the impulse response horizon based on one and two standard error bonds, however based on two standard error bonds it's become statistically significant after 3 quarters. The positive

response of inflation to oil demand shocks driven by worldwide REA is consistent with (Kilian, 2009; Peersman and Robays, 2009, 2012). However, Peersman and Robays, (2012) have examined the structural shocks effects in case of industrialized countries but the positive and sustained increase in price level in response to oil demand shock is consistent with their results especially in case of United Kingdom, while in case of other countries the response is positive but not sustained.

Finally, the third row of figure 5.6 shows that, the shock in oil precautionary demand have almost smooth and very small (near to horizontal axis) positive affect on output. The affect is statistically insignificant following precautionary demand shock over the impulse response horizon. This result is in line with Peersman and Robays, (2012) in case of Switzerland. In addition, the response of inflation following precautionary demand shock is positive at 12 quarters horizon, but its significant only for the first 6 quarters and after the mid of second year it become insignificant. So precautionary demand shock increases inflation, and this result is almost consistent with (Kilian, 2009).

In short, first the supply disruption causes a decline in output, but this decline of output is temporary with repeated pattern at all horizons and have a positive but insignificant effect on inflation at all horizon except for the first quarter. The negative affect on output/industrial production of an oil supply shocks may be due to higher cost of production because an oil supply cuts, raise the real oil prices, and can increase the cost of production. Oil being intermediate input in producing the domestic production, so the marginal cost of producing additional unite of output will be rises but the necessary condition in labor market that the price must be equal to marginal cost, to satisfy this condition the firm have to decrease the output which results domestic supply of production will decline, and inflation increases.

Second, oil demand shock has positive but insignificant effect on output at all horizon except only for the first and fifth quarters where its significant. The oil demand or aggregate demand shock causes a sustained increase in inflation which is highly significant at all horizons of the IRF. The oil price increase that driven by higher global demand affect the pakistan economy interms of higher inflation but not is the bad news for output. This means that the direct stimulating affect of global economic boom on the output of pakistan will dominate than the indirect affect of higher oil prices. Whereas in case of inflation both effects working with same direction and create higher inflation.

Third, precautionary demand shock has no effect on output, while inflation increases in response to increase in oil precautionary demand, and its significant for the first Six quarters. The higher inflation in response to precautionary demand shock as well as other two shocks may be due to higher production cost for firm, and higher transportation cost for retailer as well as for firm, and the second-round effect the declining in purchasing power, the consumer can demand for higher wages, all these costs the firm pass through selling prices, which results higher inflation because the oil-based products can be seen as an important component of CPI.

5.4.2. The Effect of Sources of Oil Price Shocks on Stock Prices and Exchange Rate.

Figure 5.7 depicts the responses of stock prices and exchange rate to the three structural shocks. The number of lags is set up to 24-months by determined through maximum horizon of IRFs. The first row of figure 5.7 represents, the response of stock prices and exchange rate to oil supply shock. There is no stock prices response to oil supply disruptions at the initial fifth months then it become negative after fifth months, but it is very small and after eight months of the shock the response become positive through 17-months and again the reaction of stock prices to negative supply shock become negative after 20-months of the shock. The very small positive and negative

stock prices response to oil supply shock is insignificant over the impulse response horizon. This means that the oil price increase due to negative supply shocks has no impact on stock prices of pakistan. The result of oil supply shock effect on stock prices is in line with the result of (Kilian & Park, 2009). The negative supply shock depreciates the exchange rate significantly up to the 5-months, and then the exchange rate become toward recovery and again it depreciates significantly after 18-months of the shock. The oil price increase driven by oil supply disruptions depreciates the exchange rate.

The second row of the IRFs in figure 5.7 describes the impact of oil demand shock on stock prices and exchange rate. The stock prices increase significantly in response to shock in oil demand up to 9-months and then the stock prices decrease insignificantly after 19-months of the shock. So, the aggregate demand shock increases the stock prices significantly for the first year. This result is consistent with Kilian and Park, 2009 whose found that the aggregate demand shock plays important role for the increasing in U.S stock prices. This result is also consistent with result of Khan et al. (2019) where they observed that, the aggregate demand shock increases the stock prices of pakistan. While on the other the aggregate demand shock depreciates the exchange rate significantly up to 5-months and then it became toward recovery. The oil price increase following oil demand shock depreciates the exchange rate for the short period of time. The result is consistent with Cunado et al. (2015) where they found depreciating affect of oil demand shock on the exchange rate of india.

The response of stock prices and exchange rate to precautionary demand shock presented by the third row of figure 5.7. The results in this row illustrate that, the stock prices increase over the impulse response horizon following oil market specific or precautionary demand shock, however the response is significant only for first 4-months. The oil price increases due to precautionary

demand shock increase the stock prices, but it is significant only for the first 4-months. On the other hand, the exchange depreciates significantly for the first 7-months due rise of oil price following precautionary demand shock. Similar result reported by Cunado et al. (2015) in case of india.

To summarize the results of figure 5.7 and provide justification, first starting from the sources of OP shocks effect on stock prices. The oil supply disruption shows negligible role in affecting stock prices of pakistan. However, the aggregate demand shock significantly increase the stock prices for the first year. This means that in case of international increase in oil demand driven by growth in economic activity around the world may be beneficial for most listed companies in pakistan stock exchange. The direct effect of strong growth in economic activity worldwide will dominate than indirect effect of raising oil prices due to higher demand for oil. Finally, the oil specific demand shock also increase the stock prices but this increase is significant only for the first four months. The oil precautionary demand arises in response to future short falls of oil supply relative to demand or increase in oil demand relative to supply. The current conditions of oil supply and demand can create uncertainty about future oil demand and supply. In our results most of the recent increase in oil prices are due to fluctuations in oil demand caused by strong growth. This may lead to uncertainty about oil demand relative to supply in near future. Thus, due to this reason we can say that oil precautionary demand may be largely increase in case of strong growth in worldwide economic activity. Which may be the reason for short-term significant and positive stock prices response to oil precautionary demand.

The exchange rate response to the three oil shocks is almost similar. The oil price increase driven by oil supply disruptions depreciates the exchange rate significantly up to the 5-months, and then the exchange rate become toward recovery and again it depreciates significantly after 18-months

of the shock. The aggregate demand shock also depreciates the exchange rate significantly up to 5-months and then it became toward recovery. Finally, the depreciation of exchange rate also occurs in response to precautionary demand shock and this depreciation of exchange rate for the first 7-months is significant and then it became toward recovery. The depreciation of exchange rate due to increase in oil prices caused by the three oil shocks may be due to higher cost of import bills, because pakistan being a net oil importer, the higher oil prices would increase the cost of import bills, which may lead to higher demand for international currency that is why the exchange rate may be depreciated.

(Estimates with One and Two-Standard Error Bonds)

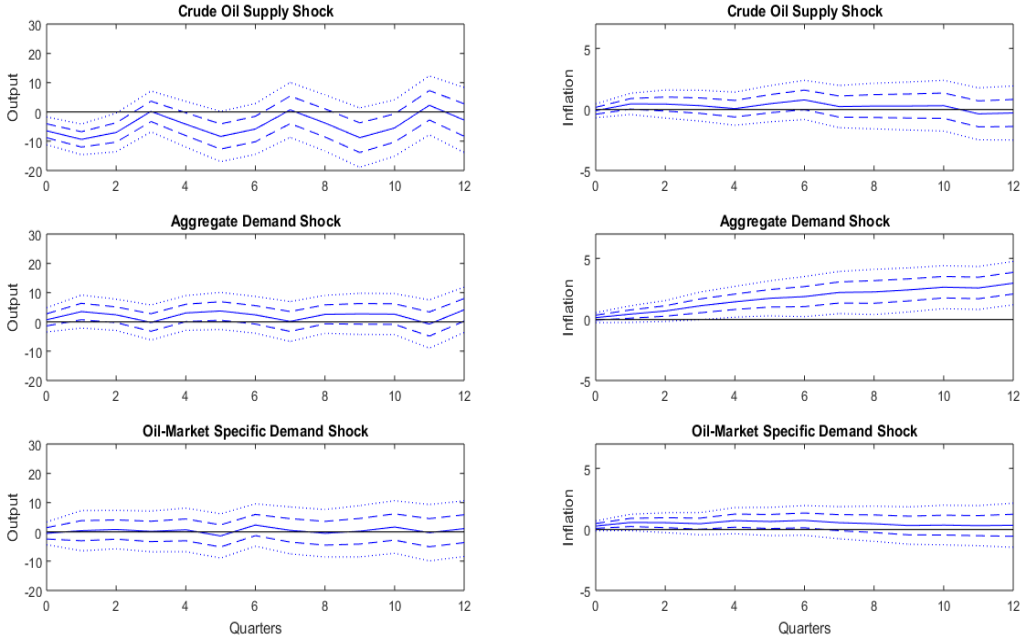


Figure 5.6: Responses of Output and Inflation to the three structural shock.

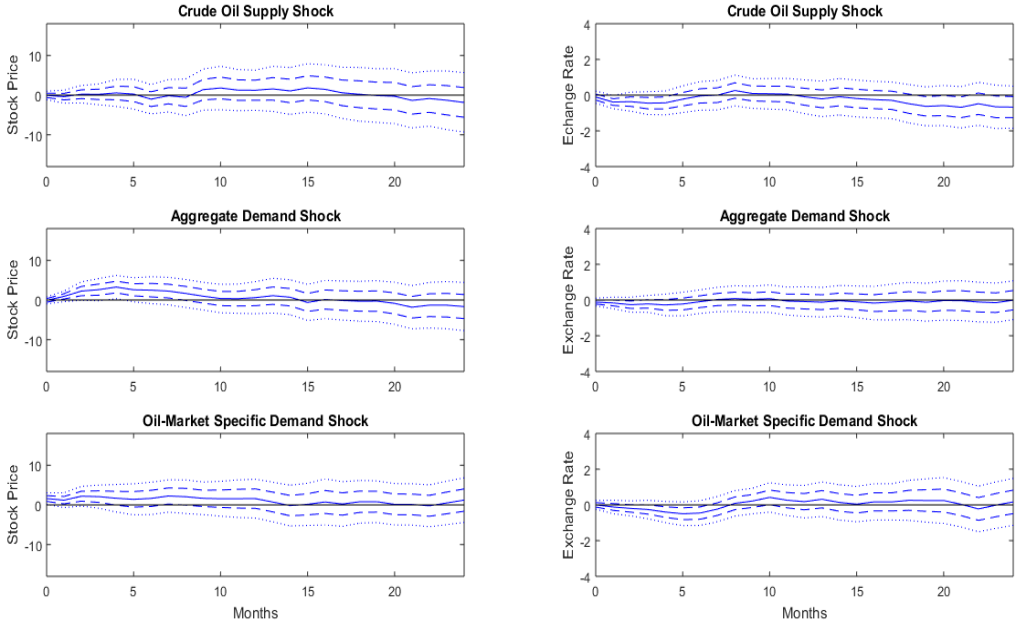


Figure 5.7: Responses of stock prices and exchange rate to the three structural shocks.

Chapter: 6

Conclusion

The study used SVAR Model of global oil market's developed by Kilian, (2009) to decompose the real oil price dynamics or to identify sources of OP shocks and then to investigate the effect of each identified source of OP shocks on output, inflation, stock prices and exchange rate of pakistan. For decomposition of real OP shocks, we used the data from Feb-1974 to Sep-2020, of COP, REA and RPO. And then for second part of our analysis we used the data of industrial production index of pakistan for output and for inflation we used the data of CPI. In addition, for exchange rate and stock prices we used the data of REER and KSE 100 Index. The analysis of the present study proceeded in two steps, where in the first step we have identified the sources of OP shocks through 2020. The second step where we have found that how the three structural shocks affect the output, inflation, stock prices and exchange rate of pakistan. The results of the first step of our analysis have been classified into historical evolution of structural shocks, IRFs, VD and historical decomposition of real OP shocks.

The results from IRFs suggests that, timing and magnitude of real oil price response to the three structural shocks may differ greatly. The aggregate demand (or oil demand) and precautionary demand shocks are the major contributor by affecting the real oil price fluctuations while negative oil supply shocks affect the real oil price variations but relatively small. The results from VD of real OP shocks also mainly verify the results of IRFs. The results from historical decomposition of OP shocks shows that, the shocks in oil prices, historical contribution by oil supply shocks play less important role relative to other two shocks. The historical contribution from oil demand shocks in oil price fluctuations are important. The oil-market specific demand shocks experiences with significant effect on oil price variations. Both oil demand shocks can be considered as a major

derivers of OP shocks. So, the evidence from historical decomposition, shows important differences in the relative contribution of the three structural shocks to oil price changes especially at specific time, and from the results of IRFs and VD we find that the timing and magnitude of real oil price response to the three structural shocks may differ greatly. Thus, this means that not all OP shocks are alike, that is why the decomposition of real oil prices have important implications for their macroeconomic effects.

The main findings from the second part of our analysis shows that, there are important difference in how the three structural shocks underlying real oil price affect output inflation, stock prices and real effective exchange rate of pakistan. The results from figure 5.6 we find that the oil price increases that result from oil supply disruptions causes a decline in output, but this decline of output is temporary with repeated pattern at all horizons and have a positive but insignificant effect on inflation at all horizons except for the first quarter. Second, the oil price increases caused by oil demand shocks has positive but insignificant effect on output at all horizons except only for the first and fifth quarters where its significant. The oil demand or aggregate demand shocks causes a sustained increase in inflation which is highly significant at all horizons of the impulse response function. Third, precautionary demand shocks have no effect on output, while inflation increases in response to increases in precautionary demand for oil, and its significant for the first Six quarters.

From the results of figure 5.7 we also find that the increase in real oil prices that result from oil supply disruptions does not play any significant role in affecting stock prices of pakistan. while the exchange rate depreciates significantly up to the 5-months, and then the exchange rate become toward recovery and again it depreciates significantly after 18-months of the shock. Second, the aggregate demand or oil demand shocks driven by global economic activity significantly increase

the stock prices of pakistan for the first year, however the stock prices lower after 19-months of the shock, but this decrease in stock prices is statistically insignificant. The exchange rate in response to aggregate demand shocks depreciates significantly for the first 4-months and then it became toward recovery. Finally, the increases in real oil price that resulted from precautionary demand shocks there is a significant increase was observed in stock prices only for the first 4-months and then the response remains positive but insignificant over the 24-months horizon. The oil market specific demand shocks or increase in precautionary demand for oil depreciates the exchange rate significantly for the first 7-months. The exchange rate appreciates after 8-months but this appreciation of exchange is statistically insignificant.

6.1. Policy Recommendations

From the policy perspectives our results suggest the importance of understanding the sources of OP shocks to better cope with their effects on pakistan economy. The central message from this study is that the OP shocks have a different effect on output, inflation, stock prices and real effective exchange rate of pakistan, depending on the underlying sources of OP shocks. The increase in real oil price that result from negative supply shocks affect the pakistan economy interms of output loss and depreciation of real exchange rate. While the increase in real oil price that result from oil demand shocks affect the pakistan economy interms of higher inflation, increasing stock prices and a short-term depreciation of real exchange rate. Finally, the oil price increases due to precautionary demand shocks affect the pakistan economy interms of higher inflation, short-term increase in stock prices and a depreciation of real exchange rate. The government can mitigate the output loss due to negative supply shocks and can control for higher inflation that caused by oil demand and precautionary demand shocks by controlling for exchange rate depreciation that effected by all the three structural shocks.

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